AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 12, No. 1. WEEKLY. | NEW YORK, THURSDAY, JANUARY 3, 1889. | $2.50 per Annum. SINGLE COPIES 5 CENTS

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The Griscom Duplex Steam Pump.

The pump here shown has so far been wholly used as a mine pump, but the principle is capable of adaptation to any service. Steadiness in operation is attained by the design of the valve motion, it having no connecting rods or fly wheels, as are sometimes employed in this class of pumps, intended for mining purposes. Dispensing with these also helps to make possible a much higher speed than is usually obtained by duplex pumps.

As will be seen from the engravings, the crosshead is attached direct to the piston rod, and motion is imparted to the steam valve by a motion block, which travels in guides and gives motion to a balanced crank attached to a shaft, upon which is keyed a quick-throw eccentric. By means of this, eccentric motion is imparted to a rotary valve, which is instantly thrown open and remains open during seven-eighths of the stroke, affording an economical use of the steam. It is through this arrangement or combination, together with the absence of connecting rods or fly wheels before referred to, that the makers are enabled to obtain the high speed which is a characteristic of this pump.

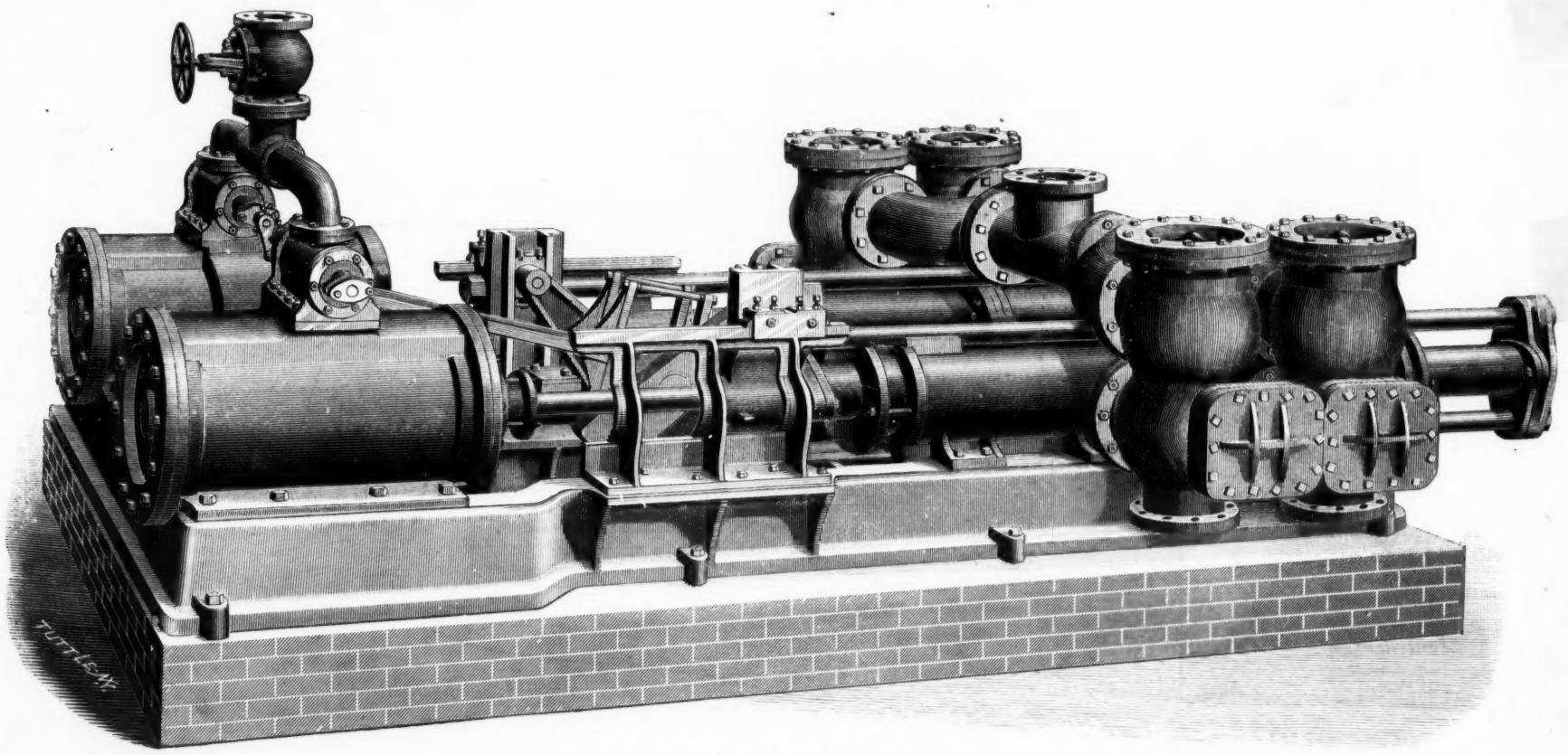
The plungers, water valves and seats are made of phosphor bronze or gun metal, whenever required to withstand the acid usually found in mine water. For a similar reason the water barrels, water chambers and the suction and discharge pipes are constructed of a peculiarly hard, close-grained iron.

The pump is compact and well built, all parts being fitted to United States standard gauges, and interchangeable.

Referring to the matter of speed already mentioned, we are informed that it is not an uncommon occurrence with these pumps, working under heavy head, to attain a speed of 200 to 250 feet per minute, without jar or shock, and throwing a steady stream of water. One of these pumps, having 10-inch water plunger, 24-inch steam cylinder, and 36-inch stroke, has just been started under a vertical lift of 515 feet, and is making a piston speed of 240 feet, discharging 2,000 gallons per minute.

The outline cuts on page 2, which have been prepared from working drawings, show the construction and proportions.

These pumps have been adopted by a number of large mining corporations in the anthracite and bituminous regions, in place of rod, Cornish and single-acting pumps, to which, we are told, they have been found superior in every respect. The manufacturers are the Vulcan Iron Works, Wilkesbarre, Pa.



THE GRISCOM DUPLEX STEAM PUMP.

Design, Construction, Repairs and Management of Marine Steam Engines and Boilers.

BY W. H. HOFFMAN.

TWENTY-THIRD PAPER.

The wooden seatings in the top flanges of upright girders will be 2¾ inches thick and 5 inches wide, and will run athwartship of the girder flanges.

These flanges will have a length over all of 32 inches, and a total width of 20½ inches, so that we can get in four pieces of well-seasoned yellow pine, of the dimensions given above, and these will project ¼ of an inch above the faces of the flange.

The upper flanges on all of the cylinders will be alike, and will be 5¼ inches thick, including the tongues and grooves that receive the wooden seatings.

The lower flanges will have no wooden seatings in them, as the seatings are placed in the top flange of the bed-plate. These frame flanges, as before stated, are 4½ inches wide all around the legs of girders, and they will be 3½ inches thick.

The holes for supporting the cores of the frames will be cylindrical, and will be covered with finished cast-iron plates.

This completes the description of the frames, and I will here make a few remarks about the guides not heretofore mentioned. They are, of course, water back guides; the main faces on which the gibs travel are planed into the girder body ⅝ of an inch, and the faces are four inches wider than the water back, thus leaving a flange on each side of the guide 2 inches wide, and in these flanges will be placed four 1⅛ inch bolts on each side; the top end of the guides being secured by the steel studs mentioned in the twenty-second paper.

We now come to the main bed-plate on which the whole of the upper structure rests. Were it not that I intend to illustrate this bed-plate, as well as some other details, I should be compelled to make a lengthy description of this casting. The main bed-plate of our engine will be of the type mentioned in the issues of the MACHINIST of March 17th and 24th, 1888, and therefore will be termed the combination bed. There will be four wrought-iron plate webs, or stems, on each side of this structure; each four, with its castings, will constitute one of the longitudinal stringers. The two stringers will rest on the wooden seatings made fast in the keelsons, and will have cast-iron plates riveted to the stems, at the top and bottom of stringers. The top and bottom castings will be 21 feet long and 27 inches wide, the former having a total thickness or depth of 6 inches, including the tongues and grooves for the wooden seatings, and the latter a thickness of 2½ inches at the central portion, and 3½ inches at the projecting outside flanges.

There will be two cast-iron transverse stiffeners, 1⅜ inch thick, where each central truss crosses to join the two side stringers, and these will be riveted to place by 1¼-inch rivets. The top and bottom plates will each have two vertical flanges, 3 inches thick and 4 inches deep, cast 15 inches apart, and to these flanges will be riveted steel or wrought-iron upright stems, the stems being ⅝ inch thick and 18 inches deep, thus forming a bed-plate with a total depth of 24 inches at the two sides, though the central cross trusses will project below the stringers 11 inches. The crankshaft boxes, six in number, are each 12 inches long net bearing, or 13¾ inches total.

As stated in the third paper, there will be no end flanges on the boxes, therefore the two cross ribs of the cross trusses will be 11 inches from outside to outside, and the rib will be 2⅝ inches thick at the top, and 1⅞ inch thick at the bottom edge. The holes in the central portion of these cross ties will be the size of the bronze boxes on the outside (20 inches), and around these holes will be facing bands, 2¾ inches wide, faced flush with the boxes.

Center ribs, directly under the center of the main boxes, will make the bearing for a flat, steel truss bar, 1½ x 2½ inches, that will be shrunk onto the cross truss, suitable lugs on the ends of the castings being provided to secure the steel bars to the main castings.

At this point I will remark that it will be readily understood that we shall have sufficient room between the bed-plate and the main keelson of the ship, as the draught about midship is 16 feet 6 inches, and 17 feet 6 inches aft, the propeller wheel being 14 feet 9 inches in diameter, as stated in the third paper. While discussing this point, it may be well to compare the draught aft to the diameter of the propeller, when it will be seen that we have (at the mean load line) the whole propeller immersed 2 feet 9 inches, a

distance that will surely prevent air from reaching the wheel.

Nothing less than 20 inches depth of water above the blades of the wheel will exclude the air, which, if allowed to reach the wheel, will reduce its efficiency directly as this *solidity* of water is reduced.

According to the dimensions in the third paper, there will be two forged steel caps over each main box, or twelve caps in all. They will be $3\frac{3}{4}$ inches deep and $4\frac{1}{2}$ inches wide, bored to fit the shell of the box, and planed with a lip to fit the main cross truss casting, and each of these caps will be held in position by two steel bolts, $1\frac{3}{4}$ inches in diameter.

The end flanges, where they join the longitudinal stringers, will be $2\frac{3}{4}$ inches thick, $17\frac{1}{2}$ inches deep, and 11 inches wide; two 3-inch bolts, passing entirely through the stringers, will hold the cross trusses in position. The bottom edges of the ribs, forming the cross trusses, will curve downward from the top side of the lower stringer flanges to a point 25 inches below the center of the shaft. At each point on the longitudinal stringers, where the legs of the upright girders rest, will be inserted the seasoned yellow pine seatings mentioned in detail in the second paper.

The thickness of the cast-iron around the bronze boxes will be 3 inches, and the center ribs connecting the two side ribs will also be 3 inches thick at the junction.

The bolts for holding the bed-plate stringers to the engine keelson will pass entirely through the main stringers and between the two side stems.

By following this description closely, it will be seen that each cross tie or girt in which the bearings are formed is a complete section in itself; the steel or wrought-iron reinforcing bars being in reality a part of the casting after they are shrunk on. In this design we have not only the elements of great strength, but also the minimum of weight. Fifty tons, saved in the total weight of the engines and boilers of a marine engine, adds that much carrying capacity to the coal bunkers or freight hold, saying nothing of the expense in making and handling the enormous castings now used in the construction of marine engines.

The economic use of material in engine construction has developed the practical high speeds of steam yachts and torpedo boats, and the same principle, carried out in larger vessels, will give the desired increase of speed to the latter.

Force in the Steam Engine and its Relation to Smooth Running.

BY PROF. JOSEPH TORREY.

EIGHTH PAPER.

Before going on, I will give two formulæ which were published by John W. Nystrom in the AMERICAN MACHINIST for Dec. 27, 1884. They are for finding the amount of inertia at the back end and at the front end, that is, the force to be laid off on ordinates 0 and 11. In these formulæ

F = Force of inertia in lbs.

W = Weight of all the reciprocating parts (commonly about three pounds per square inch of piston area).

R = Length of crank in feet.

n = Revolutions per minute.

L = Length of connecting rod in feet.

For the force of inertia at the back end the formula is

$$F = \frac{W\,R\,n^2\,(L+R)}{2933.54\,L}$$

and for the front end

$$F = \frac{W\,R\,n^2\,(L-R)}{2933.54\,L}$$

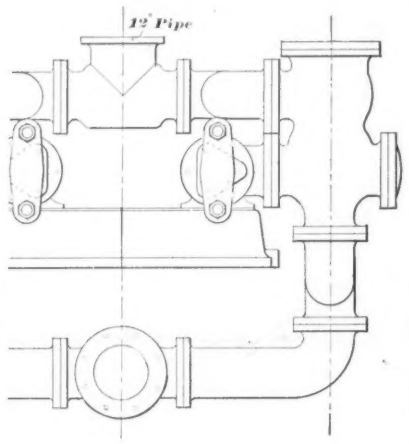
A formula is also given by which the distance from the middle point of the stroke to where the inertia curve crosses the neutral line can be found.

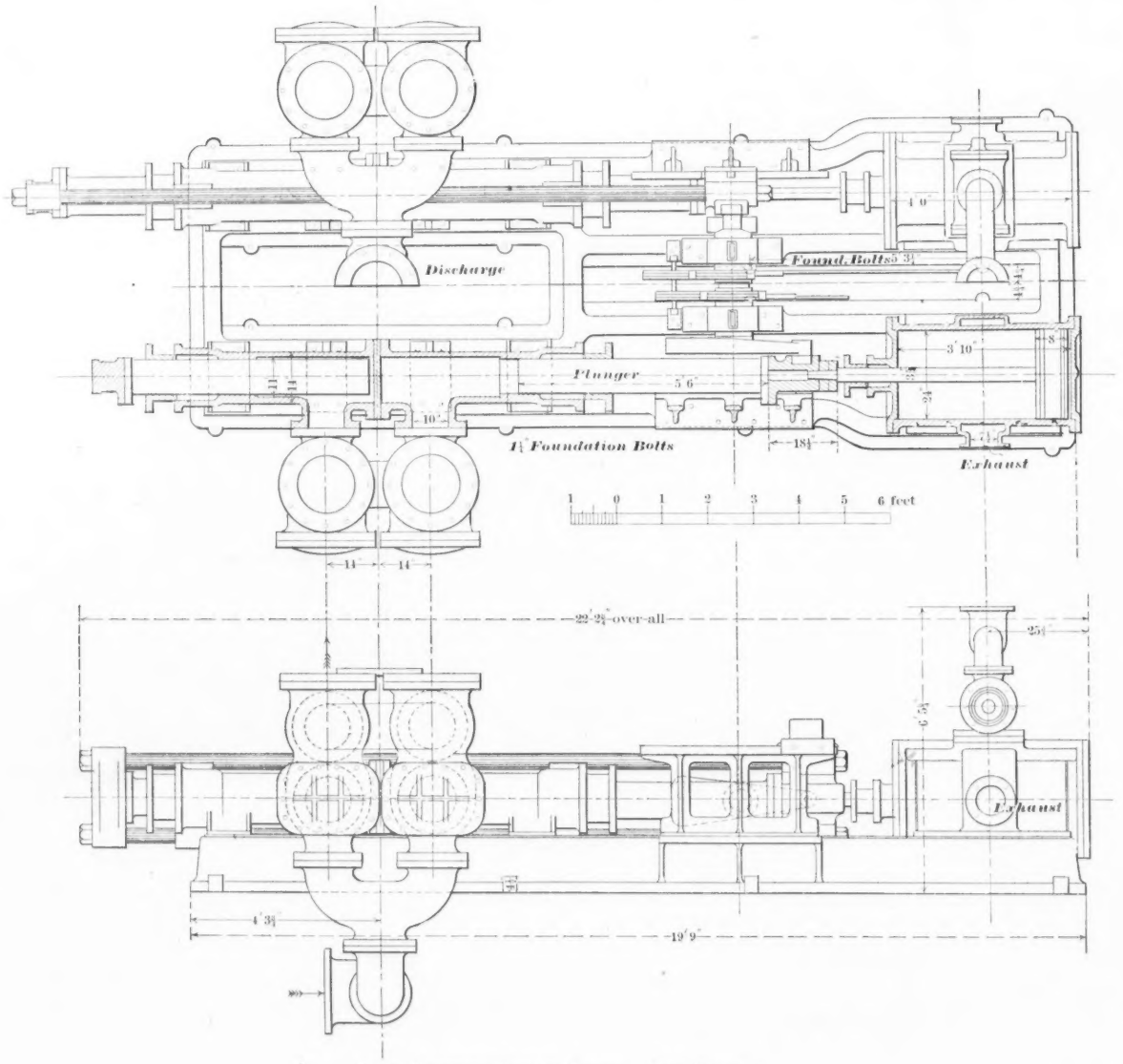
The formula is

$$d = \sqrt{L^2 + R^2} - L$$

Using the first two formulæ would give somewhat more accurate values for the end inertia forces than the method given in the last paper.

Having now traced the inertia curve, and having a table by which we can easily trace it for any engine we please, let us see what the practical bearing of this curious phenomenon of force is on the question of smooth running.





THE GRISCOM STEAM PUMP.—SEE PAGE 1.

Suppose the backward stroke to be just completed, the engine being just ready for the forward stroke, what is the state of the bearings and journals along the line of centers? They all *must be* set over strongly in the direction of the cylinder, because the piston has been pulling the reciprocating parts toward itself. Now, at the beginning of the forward stroke, the first thing to be done is to get the reciprocating parts in motion forward. *Until this is done, there is no pressure on the crank-pin at all.* This will be more easily seen if we suppose the crank-pin, for instance, to be loose in its box. Then it is plain that, at the end of the backward stroke, there would be some actual space between the crank-pin and the connecting rod box, on the cylinder side. Now, clearly, the piston, piston rod, crosshead and connecting rod must move till that small space has been passed over, before they will exert any force on the crank-pin. In the same way, and supposing the pin to have little or no lost motion, it is perfectly clear that before there can be *any* push on the crank-pin; the reciprocating parts must be in motion; but we have seen in previous papers that considerable force is required to start the reciprocating parts at the ends of the stroke with the required velocity, and that almost all the way through the forward stroke, the speed of these parts being on the increase, some force is required to do the work of *accelerating*, or adding velocity to them. That means that all the steam pressure during the first half of the stroke is not exerted directly on the crank-pin; a good part of it never sees the crank-pin till considerably later. But how about the last half or part, rather, of the stroke? Remember that, at a point a little before half stroke, the piston speed stops increasing, and begins to be retarded or slowed down by the crank movement. What is the result of this? We have seen that, by virtue of the weight and speed of the reciprocating parts, they resist being stopped, and, of course, they resist *against the crank-pin*. The action is precisely like a locomotive trying to stop with a heavy train of freight cars behind it. The cars, owing to their inertia, run forward and push against the locomotive, just as described above in case of the piston, crosshead, etc. This all means that, during a little more than the last half of the stroke, the steam pressure is not all that is acting to drive the crank-pin onward; there is also the inertia of the reciprocating parts, the momentum acquired during the first part of the stroke, which manifests itself here as useful force, thus paying completely for the steam force used up in giving these parts their velocity during the first part of stroke. *There is, then, no loss of power at all from heavy reciprocating parts.* Of course there are reasons why it is best not to make them heavier than is needed for smooth running and the needed strength, but they are no source of loss.

This is not all, moreover. We saw in one of the earlier of these papers how disastrous the sudden and violent blow of the steam might prove at the beginning of the stroke. Now, see how the inertia of properly proportioned reciprocating parts modifies the case. At the very beginning of the stroke, where the steam pressure is almost always at its highest, the full force is not felt on the crank-pin; considerable is used up in setting the parts in motion. The amount of force that shall be neutralized in this way can be very easily determined by adjusting the weight of the reciprocating parts so that their inertia (= the force needed to start them with their required velocity) shall be about one-half the total steam pressure on the piston at the beginning of the stroke. This action keeps up all through the first part of the stroke, while the reciprocating parts are constantly increasing their velocity; a portion of the steam pressure is used up in imparting this constantly increasing velocity, and is not felt at the crank-pin. To sum up, then, the effect of inertia during the first part of the stroke is to relieve the crank-pin of a large portion of the steam pressure.

In the last part of the stroke, the case is just opposite. The steam has probably been cut off before half stroke, and the steam pressure in the cylinder is rapidly falling, resulting in a constantly decreasing pressure on the pin; but *inertia*, on the contrary, is on the increase, and this inertia, we have seen, makes itself felt as a constantly *increasing* impelling, or driving force at the pin. Now, notice the result. When the steam pressure is highest, inertia acts *against* and neutralizes part of it; when it is decreasing, inertia acts *with* it, and adds to the pressure felt at the crank-pin. The result is a much more uniform pressure throughout the stroke, and consequently less strain on the pin than there would be without inertia. I have tried to explain this curious and subtle action of inertia clearly. It will take, however, some little thought to master it. The ideas and conceptions involved are entirely new to very many engineers, doubtless, and prove confusing unless thoroughly and patiently studied.

In the next paper we will study the action of these compensations in case of several actual engines of well-known and excellent makes.

We have just entered now on the practical and interesting part of our study; what has been considered in this paper is only a very small beginning of the hunt we shall take after the force that is applied to the piston by the steam. It goes in many directions, and a better understanding of its amount and distribution in each will doubtless "make better engines and better engineers," as Mr. Ball says.

Practical Drawing.

BY J. G. A. MEYER.

SIXTY-SEVENTH PAPER.

Problem 78.

523. *Development of surfaces.* Let $e\ f\ g\ h$, Fig. 416, be the vertical, and $e_2\ a_2\ g_2\ a_4$, Fig. 417, the horizontal projection of a geometrical solid; it is required to find the development of its surface.

To state our problem in a practical light, we may say, that Fig. 416 represents an elevation, and Fig. 417 a plan of a sheet-iron casing; it is required to find the correct outline of the sheet of metal, before it is bent or rolled to the required form shown in Figs. 416, 417; the thickness of the metal is supposed to be so small that it may be neglected. For the sake of clearness, we have shaded Fig. 417 so as to represent a casing, or, we may say, so as to represent the limiting surface of a geometrical solid. (See Art. 18.)

In the first place, let us consider what kind of surfaces there are represented in Figs. 416, 417. We see that in Fig. 417 the junctions of the curves and the straight lines are at the points a_2, a_4; b_2, b_4; c_2, c_4; and d_2, d_4. The lines $a_2\ c_2$ and $a_4\ c_4$ are represented in Fig. 416 by a portion of the line $e\ g$, namely, by $a\ c$; and the lines $b_2\ d_2$, $b_4\ d_4$, which in Fig. 417 coincide with the lines $a_2\ c_2$, $a_4\ b_4$ respectively, are represented in Fig. 416 by a portion of the line $f\ h$, namely $b\ d$. Here, then, we see that, in Fig. 416, the surface bounded by the straight lines $a\ c$, $b\ d$, $a\ b$, $c\ d$ is the vertical projection of the two surfaces, which in Fig. 417 are represented by the lines $a_2\ c_2$, $a_4\ c_4$; and we see furthermore that these are plane surfaces, or, as the practical man would say, straight surfaces. Again, the projections also show that, in Fig. 416, the surfaces bounded by the lines $a\ b$, $e\ f$, $a\ e$, $b\ f$, and $c\ d$, $g\ h$, $c\ g$, $d\ h$ are curved surfaces; and lastly, Fig. 416 *A* indicates that these surfaces are portions of a cylindrical surface with circular base; the lines $a\ b$, $c\ d$ in Fig. 416 are the junctions of the straight and cylindrical surfaces, and they also represent planes perpendicular to the vertical plane of projection, passed through the axes of the cylindrical surfaces.

We will now proceed to find the required development of the surfaces. Through the point c (Fig. 416) draw a line $c\ 5k$ perpendicular to $c\ d$; again, through the point d, draw a line $d\ i$, also perpendicular to $c\ d$, and meeting the line $g\ h$ prolonged in the point i. Prolong the line $d\ c$ upwards, and on this line choose any point x at any convenient distance above $e\ g$; through the point x draw a line $x\ 5l$ perpendicular to $d\ x$, and meeting the line $g\ h$ prolonged in the point $5l$. From the point x as a center, and with a radius equal to $x\ 5l$, or $c\ 5k$ (but not equal to $c\ g$) describe the $l\ 5l$, meeting the line $d\ x$ in the point l. Divide the arc $l\ 5l$ into any number of equal parts, say four, and thus obtain the points of division $2l$, $3l$, $4l$. Through these points draw lines parallel to $d\ x$, and cutting the line $e\ g$ in the points $2e$, $3e$, $4e$; the line $c\ 5k$ in the points $2k$, $3k$, $4k$; and the line $f\ h$ in the points $2d$, $3d$ and $4d$.

Suppose, now, that the surface or casing is cut at the line $r\ s$ and then opened, or spread out so as to lie flat on the paper; this surface will then appear as shown by the shaded part in Fig. 419. To find the outline of this shaded part, that is, the development, we continue as follows:

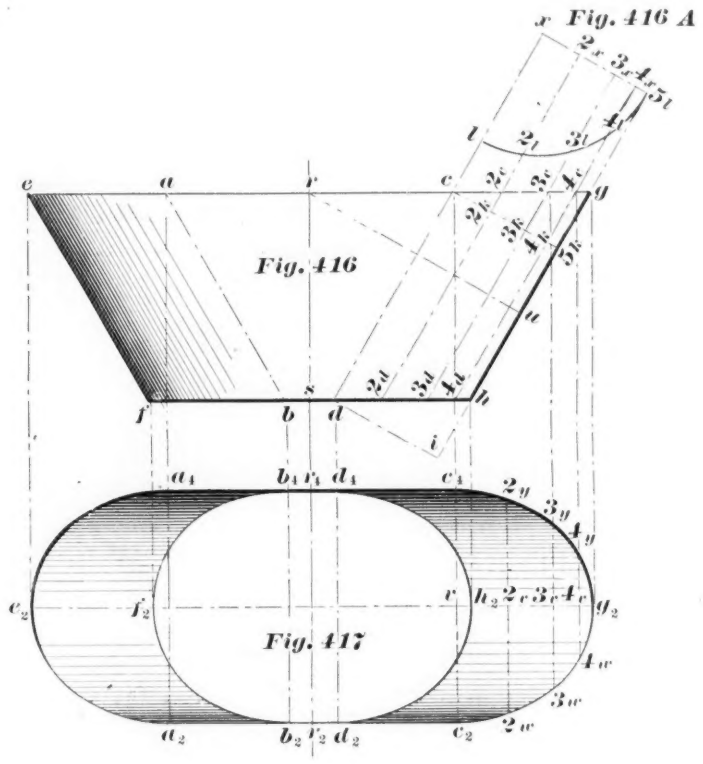
Draw the horizontal line $m\ o$ (Fig. 419), and make it equal to $a\ c$ (Fig. 416). Bisect the line $m\ o$, and thus obtain the point r_3; through this point draw the line $r_3\ s_3$ perpendicular to $m\ o$ and make $r_3\ s_3$ equal to $r\ s$ (Fig. 416), and through the s_3 draw a line $n\ p$ parallel to $m\ o$. Make $n\ p$ equal to $b\ d$ (Fig. 416) and let one-half of $n\ p$ lie on each side of the center line $r_3\ s_3$; join the points m, n and o, p by straight lines. We thus obtain a figure $m\ n\ o\ p$ which is equal to $a\ c\ b\ d$ in Fig. 416. This is as it should be, because in Fig. 416 the straight surface $a\ b\ c\ d$ is parallel to the vertical plane of projection, consequently, we see its true outline, and therefore $m\ n\ o\ p$ in Fig. 419 must be equal to $a\ b\ c\ d$.

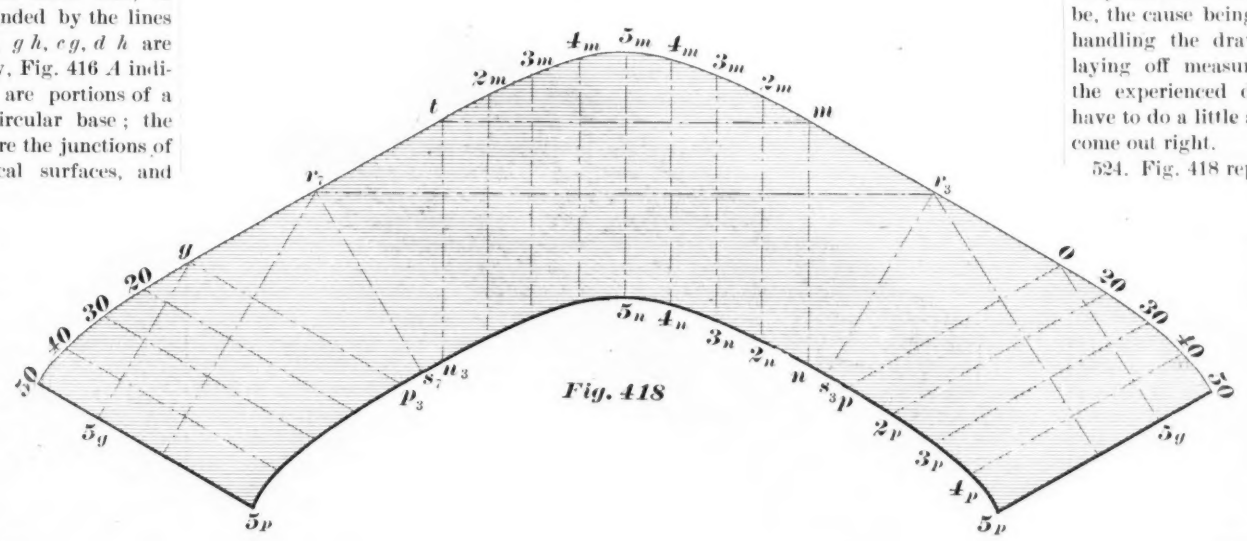
We have seen that the line $c\ d$ in Fig. 416 is a junction of the straight surface $a\ b\ c\ d$, and the curved surface $c\ d\ g\ h$; therefore in Fig 419 the line $o\ p$ will also represent the junction of the straight surface $m\ n\ o\ p$ and a cylindrical surface. Now assume that in Fig. 416 the cylindrical surface extends only to the line $c\ 5k$, and extends downwards to the line $d\ i$. The lines $c\ 5k$ and $d\ i$ are by construction perpendicular to $c\ d$, and therefore the rectangle $c\ d\ i\ 5k$ represents one-half of the surface of a right cylinder; that is, a cylinder whose axis is perpendicular to the bases (see Art. 299); and we also know that these bases are circles. According to Problem 58, the development of a right cylindrical surface will be a rectangle, or a square depending on the ratio between the circumference and height of cylinder. In the problem before us, the cylindrical surface $c\ d\ i\ 5k$ shown in Fig. 416 is represented in Fig. 419 by the rectangle $o\ p\ g\ p_3$, and this rectangle is found in the following manner: Through the point o draw the line $o\ g$ perpendicular to $o\ p$, and make $o\ g$ equal to 3.1416 times the radius $c\ 5k$. Through the point g draw the line $g\ p_3$ parallel to $o\ p$; also through the point p draw a line $p\ p_3$ parallel to $o\ g$, and thus complete the rectangle $o\ g\ p\ p_3$, which is the development of the cylindrical surface $c\ d\ i\ 5k$ (Fig. 416).

Now, in Fig. 416 we see that the cylindrical surface $c\ g\ d\ h$ extends beyond the line $c\ 5k$, and the amount of this extension is represented by the portions of elements $2k$ $2c$, $3k$ $3c$, etc., intercepted by the lines $c\ 5k$ and $c\ g$. Therefore, divide the line $o\ g$ (Fig. 419) into eight equal parts; that is, twice as many equal parts as spaced off in the arc $l\ 5l$ (Fig. 416 *A*); through the points of division $2g$, $3g$, $4g$, $5g$ draw lines perpendicular to $o\ g$. Make $2g\ 2o$ equal to $2k\ 2c$ (Fig. 416); $3g\ 3o$ equal to $3k$, $3c$, and so on in succession, as is clearly indicated by the figures and letters. In this manner we obtain the points $2o$, $3o$, etc. Through these points draw the curve $o\ 5o\ g$. Notice that in Fig. 416 the lines $c\ d$, $2d\ 2c$, $3d\ 3c$, $4d\ 4c$ and $g\ h$ are all of the same length; therefore, in Fig. 419 make all the lines $2o\ 2p$, $3o\ 3p$, etc., equal to $c\ d$ (Fig. 416); or, what amounts to the same thing, make all these lines equal to $o\ p$ in Fig. 419; through the extremities p, $2p$, $3p$, etc., draw the curve $p\ 5p$, p_3, which completes the development of one of the cylindrical surfaces. We have now only to add, in Fig. 419, the surface $g\ p_3\ r_5\ s_5$. Through the point r_3 draw a line $r_3\ r_5$ parallel to $o\ g$. From the point g as a center, and with a radius equal to $r_3\ o$, describe a short arc cutting the line $r_3\ r_5$ in the point r_5. Through the point r_5 draw a line $r_5\ s_5$ perpendicular to $g\ r_5$, and make $r_5\ s_5$ equal to $r_3\ s_3$. Through s_5 draw a line $s_5\ p_3$ parallel to $g\ r_5$; if the construction has been correctly drawn, the line $s_5\ p_3$ will meet the line $g\ p_3$ in the point p_3 previously found; and furthermore, $s_5\ p_3$ will be equal to $s_3\ p$.

This completes the development on the right-hand side of the center line $r_3\ s_3$; the other half is to be found in a manner precisely similar to the foregoing.

If this development has been drawn correctly, then the line joining the points $s_3\ s_5$ will be parallel to the line $r_3\ r_5$; and the line joining the points $s_3\ s_7$ will be parallel to $r_3\ r_7$. It will be well to draw these lines, to test the correctness of the construction. We make these remarks, because the beginner may not get the surface $g\ p_3\ r_5\ s_5$ exactly like the surface $o\ p\ r_3\ s_3$, as they should be, the cause being a lack of experience in handling the drawing instruments, and in laying off measurements correctly. Even the experienced draftsman may sometimes have to do a little adjustment to make things come out right.





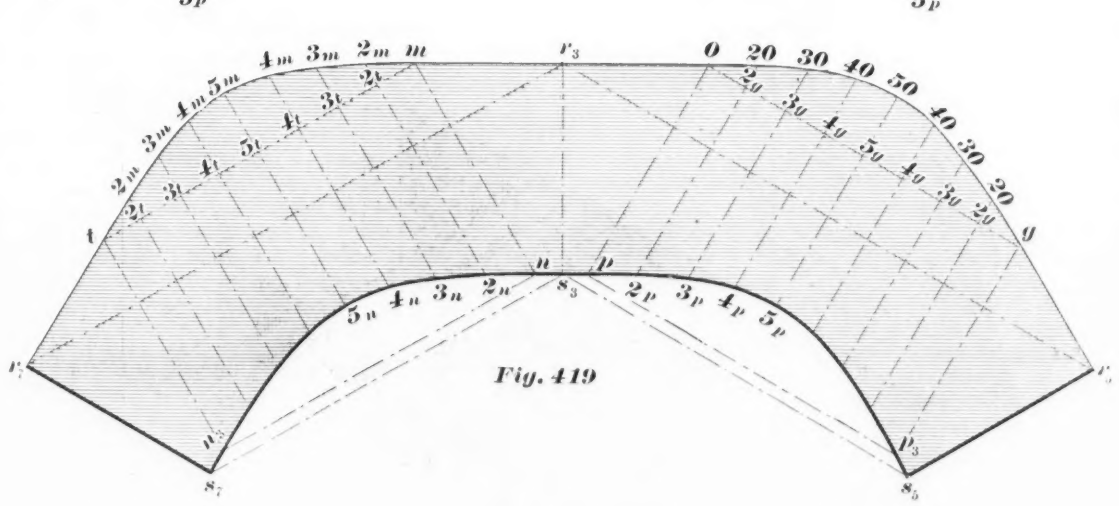


Fig. 418 represents a development of the same surfaces. In this case, after the sheet has been rolled to the required form, as shown in Fig. 416, the joint will be at the line $e\ f$ or $g\ h$. The manner of finding the development in Fig. 418 does not differ from that given for finding the development in Fig. 419.

By referring back to Figs. 413, 415, it will be seen that, in both developments shown in Figs. 418, 419, those portions which are to form the cylindrical surfaces are found by applying the principles given in Problem 77.

525. It may be well to call attention to the fact that, when the joint of the sheet of metal is to be at the line $e\ f$, Fig. 416, and the corresponding development, as represented by the shaded part in Fig. 418, is to be cut from a rectangular sheet, there will be more waste of metal than when the joint is placed at the line $r\ s$, and its corresponding development, as shown in Fig. 419, also cut out from a rectangular sheet.

A general tendency towards higher wages in England and Scotland may be taken as very good evidence that business is improving there. In fact, our English exchanges very generally agree that there has been a plain improvement, and point especially to the busy times in the Clyde shipyards as evidence. There is very good reason to believe that the manufacturing interests of the world are to prosper during the year 1889.

New Quick-Firing Guns.

The art of manufacturing quick-firing guns is still progressing. Herr Gruson, the well known maker of armored turrets, of Buckau, near Magdeburg, has also for some time been turning out revolver guns. He has found, however, that these guns are too heavy in proportion to the weight of the projectile they are able to throw, and he has therefore designed a new single-barrel quick-firing gun, which is said to meet the objection. At his works, five descriptions of the new arm are being manufactured, differing in caliber and length, but uniform in the construction of the breach and barrel. The calibers are 3.7, 5.3, and 5.7 centimeters (1.4 inch, 2 inches, and 2.2 inches) respectively. Of the 5.3 centimeter caliber, three descriptions are made, varying merely in length of barrel. The guns may be mounted in ironclad land turrets, on ordinary field gun carriages, or on pivots, giving an all-round fire, on board ship. The projectile may be shell, shrapnel, or case-shot. The charge is enclosed with the projectile in a brass central-fire cartridge. The range for the 3.7 centimeter caliber is 2,400 meters (2,616 yards), for the short 5.3 centimeter gun 3,200 meters (3,488 yards), and for the other descriptions 4,500 meters (4,895 yards). The weight of the projectile ranges from 0.45 kilogramme (1 lb.) up to 2.72 kilogrammes (6 lbs). The gun is served by two men, who can fire from thirty to forty rounds a minute. It is stated that several of the new guns have been already purchased by foreign governments.—*Iron* (London.)

Crystallization and Shrinkage of Cast-Iron.

BY S. BOLLAND.

THIRD PAPER.

Long beams of the class shown at Fig. 24 will invariably warp hollow along the deep side *A*, with more or less tendency to hollowness at plate *B*. The view is that of a lintel 12 inches wide at *B*, with webs *A*, *C* 12 and 6 inches deep respectively, and 1 inch thick all through. To secure a straight casting, comparatively free from internal strains, the proportions marked at sectional elevation, Fig. 25, must be adhered to; plate *B* $\frac{7}{8}$ inch, web *A* 1 inch, and web *C* $1\frac{3}{16}$ inch. Should the webs be equal in depth, as seen at section Fig. 26, then the webs *A*, *C* must be $1\frac{1}{16}$ inches, and the plate *B* $\frac{7}{8}$ inch.

All castings of the kind shown in perspective, at Fig. 27, warp round on the top edges if equal thickness is insisted upon, from causes already explained.

The remedy is to follow the proportions as given at Fig. 28, $\frac{5}{8}$ inch at the edges *A B*, with a gradual reduction towards the crown at *C*, which must be $\frac{3}{8}$ inch. These dimensions are given on the supposition that the casting is to average $\frac{1}{2}$ inch thick, and the proportions will be safe to follow in all such castings, irrespective of size.

Round columns come crooked, more or less, if the heat escapes quicker on one side than it does on the other; as, for instance, when the cope contains a very limited thickness of sand, or from exposure of one side before contraction has ceased; if these causes do not exist, and the core is set central, as at Fig. 30, these castings will come straight.

Sometimes cores are purposely set in the mould as shown at Fig. 29, the idea being to give a greater body of metal at the point of least pressure; this practice is to be condemned, inasmuch as it weakens the casting as well as causes it to become crooked.

There are some practices common to most foundries, which cannot be too severely criticised. Columns are often made with heavy mouldings, and bases cast on them, to save trouble and time. This should not be done, as it endangers the safety of the casting; for not unfrequently castings thus made are found to have separated at places where abrupt changes have occurred in the outline. That portion of Fig. 31 marked *A*, which represents a section of base having this fault, will give some idea of what is meant; the angles indicated by the arrows cannot be other than fractured, from the fact that crystallization of the heavy portions takes place so long a time after the thinner parts are set. The correct method is to have the body of the column run even all through, with loose mouldings and base; but when, as is often the case, the builder or architect must be accommodated at short notice, a comparatively safe column may be produced by reducing the core opposite the angles (taking care to round off the latter as seen), allowing it to gradually lose itself some distance away, as shown at base *B* and at moulding *C*. This allows the crystals to arrange themselves more uniformly in the mass, on account of the almost imperceptible change from a heavy to a lighter section of thickness.

Fig. 32 is an example of the folly of designing window sashes, etc., with all or perhaps only two of the sides of greater sectional area than the inner ribs; the latter set and contract almost instantly, pulling at the outer frame whilst in a semi-molten condition, resulting in castings similar to the somewhat exaggerated views given. The only remedy for this is to reduce the area of the heavy parts, distributing such reduction amongst the lighter ones, until a balance is obtained and equal rates of cooling assured.

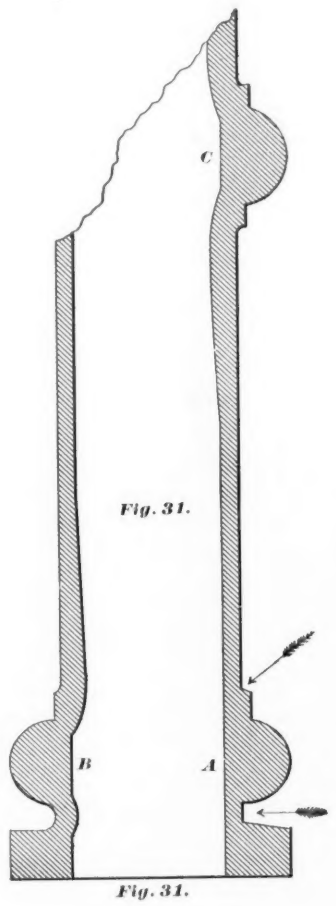


Fig. 31.

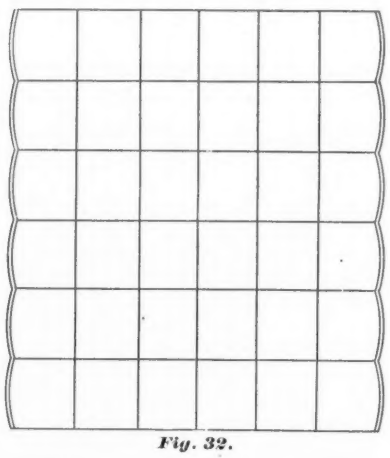


Fig. 32.

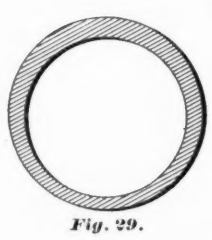


Fig. 29.

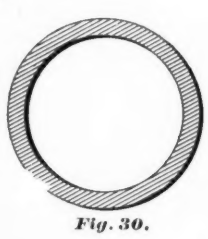


Fig. 30.

Fig. 28.

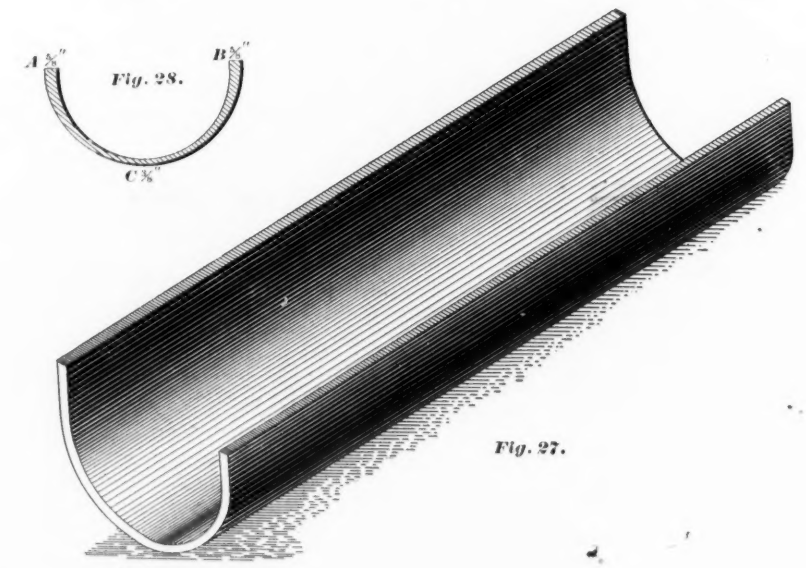


Fig. 27.

Fig. 26.

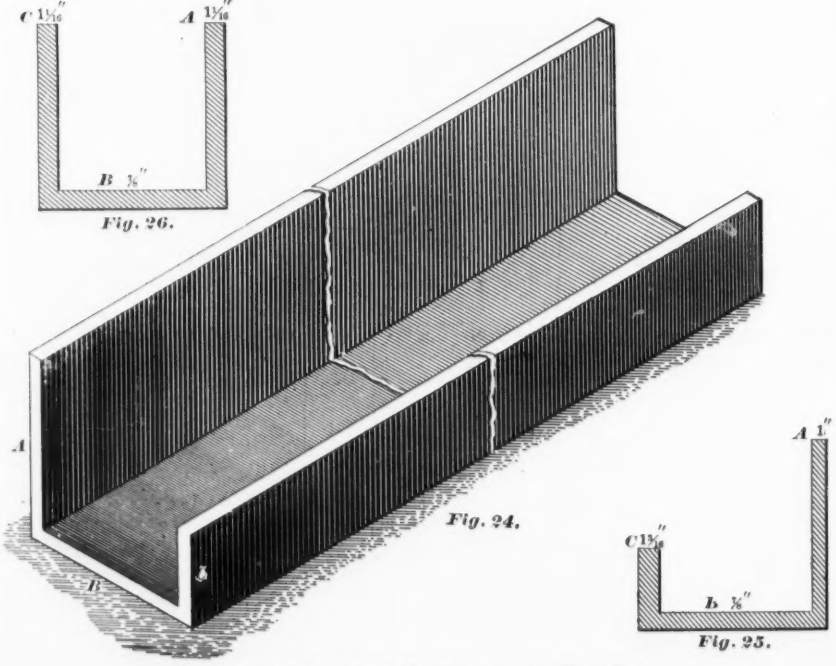


Fig. 24.

Fig. 25.

CRYSTALLIZATION AND SHRINKAGE OF CAST-IRON.

Testing Triangles and Squares.

BY PEDRO.

It is a fact well known by draftsmen that the ordinary triangles, when obtained from the dealers, are seldom, if ever, true—neither the angles nor the edges. Whether the manufacturers do not take sufficient pains to make them true, or whether they warp out of shape in the course of time, is not definitely known, but probably both these causes contribute more or less to produce the result. The fact is, that the first thing to do after purchasing triangles, is to true them up if accurate triangles are wanted.

A method often used by draftsmen in testing the angles, is partly illustrated in Fig. 1, page 5, the triangle *T* being set against the edge of a T-square *S*, a line is drawn on paper along the edge *SD*. The triangle is then reversed, as shown by the dotted lines. When the angle in this case is exactly 90°, the edge *SD* of the triangle will agree in both positions with the pencil line. The acute angles are accurately laid off with instruments on paper with fine pencil lines, and the triangles are then compared with these. This may be called the *sight method*, as the sense of sight is the only one appealed to for detecting any errors.

Another method, frequently used by the writer, may be called the *touch method*, since the sense of touch is mostly relied upon for the detection of errors in the angles. This method is illustrated in Figs. 2, 3 and 4. All the tools required to make the tests are two short straight-edges, *A* and *B*, and a long straight-edge or T-square *S*. To illustrate the process, we take the T-square blade or a straight-edge *S*, and clamp it on a table or drawing board. The triangle *T*, Fig. 2, is held firmly against the edge *S*, while the straight-edge *A* is placed against the other edge of the triangle. Holding the straight-edge *A* firmly in this position, the triangle *T* is removed, and a straight-edge *B* put in its place against *A*, as shown in Fig. 3. If, now, the straight-edge *A* is removed, and *B* held firmly upon the table, the left-hand edge of *B* will occupy exactly the same position that the edge of the triangle *T* did in Fig. 2, as indicated by the dotted lines in Fig. 3. If we now replace the straight-edge *A*, Fig. 3, by the triangle *T*, as shown in Fig. 4, the angle of the triangle, if correct, will fit exactly into the angle formed by the straight-edges *B* and *S*. If the triangle is not true, the error will show double its actual amount in this instance; that is, the angle of the triangle in Fig. 4 is less than 90°, by one-half of the amount indicated by the angle *C*. The reason of this is evident, from the fact that the space above the straight-edge *S*, measured in degrees, is 180°, and hence the 90° angle must be measured off twice to fill this space. If the angle of the triangle is too large or too small, the error will likewise be measured off twice, and hence it will show double its actual amount.

In the same manner as above, any other angle of the ordinary triangles may be tested and corrected. In case of the 60° angle, it will have to be laid off three times to make 180°, and hence, any error in the angle will show three times its actual amount. In case of the 45° angle, the error will be multiplied four times, and six times in testing the 30° angle.

These tests could be made with only one straight-edge, besides the T-square, by removing the triangle *T* in Fig. 2, directly to the opposite side of the straight-edge *A*, taking the position shown in Fig. 4. But in that case it would require the two edges of the straight-edge to be perfectly parallel, and as it is not an easy job to make such a straight-edge, two are preferably used, since parallelism is then not necessary.

The superiority of this method over the sight method, previously referred to, is at once apparent. We can feel assured that the edge of the triangle, in its second position, Fig. 4, when placed against the straight-edge *B*, coincides exactly with its first posi-

tion, Fig. 2, and if the angle with which we are "measuring off 180°" is perfectly true, the other edge will also coincide with the straight-edge *S*. If the angle is not perfect we can detect it, even if the error *C*, Fig. 4, is so small that it cannot be detected by the eye, the sense of touch being so much more sensitive.

There is a slight modification of the touch method represented in Figs. 5 and 6, and may be called the *sight-touch method*, as it is a combination of the two methods described above; that is, the senses of sight and touch are both brought into action in the last operation of the tests. The process is the same as in the touch method, with the following exception.

The straight-edge *S*, Fig. 5, should be as light as possible, so it will slide easily upon the table in turning slightly about a pin *G*, set in the table. The straight-edge *S* is set against the pin *G*, and a mark *E F* drawn along each edge at the end. The straight-edge is held in this position while the triangle *T* is set against it, as shown in Fig. 5. This is the first position of the angle in the process of measuring off 180°, as previously described. The last position of the angle is shown in Fig. 6. The triangle *T* is set into the angle formed by the last position of the straight-edge *B* and that of *S* If the angle of the triangle is not true, the straight-edge *S* will adjust itself to the edge of the triangle by swinging about the pin *G*, and the amount of the error in the angle can be seen by the distance the end of the straight-edge *S* swings from the mark *E* or *F*, as shown in Fig. 6. In this method, any error in the angle is exaggerated by the tests, as in the previous method, and, in addition, it is still further magnified, according to the distance from the pin *G* to the end of the straight-edge at *E*. If the angle is correct, the edges of *S* will coincide with the marks *E F* in the last setting, Fig. 6, as well as the first, Fig. 5.

The above methods are applicable to machinists' and carpenters' squares, as well as draftsmen's triangles.

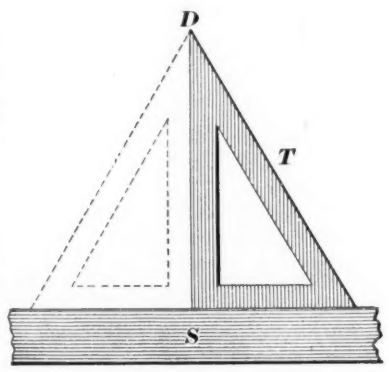


Fig. 1

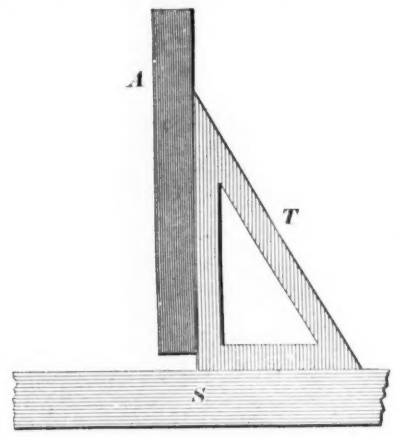


Fig. 2

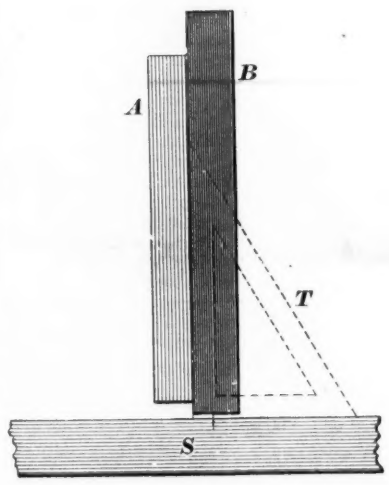


Fig. 3

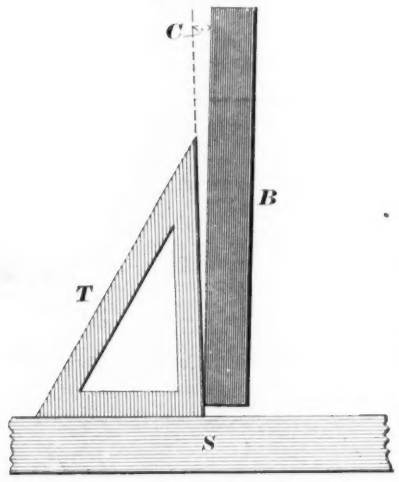


Fig. 4

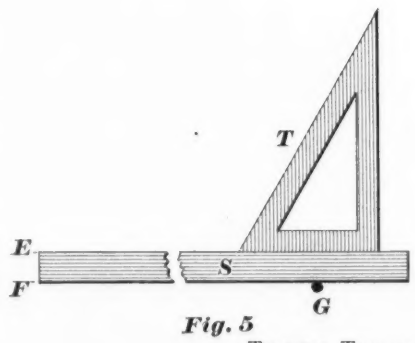


Fig. 5

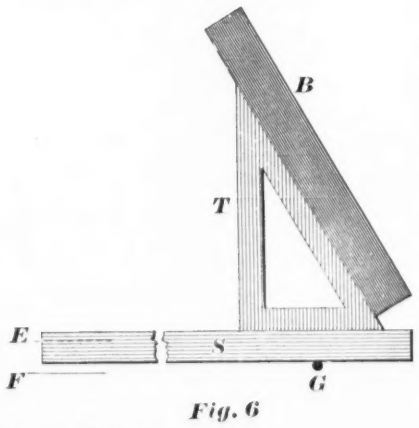


Fig. 6

TESTING TRIANGLES AND SQUARES.

LETTERS FROM PRACTICAL MEN.

Comparison of Steam and Gas Engines.

Editor American Machinist:

Having read the article by Geo. B. Grant, in the AMERICAN MACHINIST, No. 52, Vol. 11, I would like to offer a few figures in favor of the *gas engine*, which, I believe, will demonstrate that the gas engine would cost less to operate than the steam engine (as in the above case).

Assuming that the steam engine costs $400 and the gas engine $1,100, the interest, tax and repairs would be for the steam engine $40, and for the gas engine $110. The steam engine would require half of the time of one man to fire, oil and clean the engine, which, at $1.50 per day, would be for one year (300 days) $225. The gas engine would only require one-tenth as much, which would be $22.50. The cost of fuel would be for the steam engine, about five lbs. per horse-power per hour, twelve hours per day (this comes from banking the fire at night or lighting it in the morning), and at five dollars per ton would be $150 per year.

The gas engine, with oil at 7 cents per gallon (the price here per gallon by the barrel), would cost seven-tenths of one cent per horse-power per hour, or $84 per year.

The heating for five months (21 weeks) at five dollars per ton for coal, would be for 6½ tons about $33; therefore the recapitulation:

Steam Engine.		*Gas Engine.*
$ 40.00	Interest, tax, repairs	$110.00
150.00	Fuel.....	84.00
225.00	Attendance.....	22.50
....	Heating...	33.00
$415.00		$249.50

Balance in favor of gas engine, $165.50.

Mr. Grant makes a mistake when he puts the coal at 4 lbs. per horse-power per hour; he forgets that he would either have to bank his fire at night or else fire up a cold boiler in the morning, both of which operations would require extra coal, while he would only have to spend 15 minutes twice a day to clean and start the gas engine. And then again, $1,100 is a high price for an 8 horse-power gas engine (per my catalogues, $800 would be about right). This would make $30 more in favor of the gas engine, or $195.50, which, in ten years, would buy three or four steam engines.

The steam pipes for heating would cost about the same, or more than the stoves.

JOSEPH J. HARROP.

Making a Stove for the Foundry—A Moulder's Plan for Making a Gear—Cleaning Window Glass.

Editor American Machinist:

For the past two winters I have had some difficulty in keeping the shop warm, with the stoves provided. I tried to think of some plan to make it comfortable for the men this winter, and I have succeeded so well that the shop is now comfortable in the most remote corner from the stove. My plan consisted in making a stove, which cost (exclusive of the iron) about $3.00, and hoping it may benefit others, I will explain the method of making it.

There was a 36-inch pulley lying around, which would not do for the purpose for which it was made, so I knocked the arms out of it and used it for a fire-box. I then found a grate pattern about the size I wished, which I cast with the addition of lugs in the side, with holes for pins or bolts, to hold the cylinder in place on the grate. My grate pattern was in three sections, or one-half of the circle, so I bedded it in half of the circle and finished; then I drew out the pattern and did the same on the other half, so as to form a solid, round grate. Then I took a gate stick, about 1½ inches in diameter, and pressed it down about 12 inches on the outside rim, to form legs to elevate the grate. I then put bricks over the cores and cast in open sand.

Another good plan (when there is no pattern) is to level a bed and strike out the size of your grate, then with a gate cutter you can soon fashion out a grate that will last for years, if the ashes are kept away from the bottom of it.

The section I used for a fire-box was 36 inches by 18½ inches; 18½ inches was not deep enough, so I made another one of the same depth with three guides on the outside, to hold it in position on the other; this was to give radiating surface to the stove, and it is a fine thing. I then cast a round plate with three guides on the side, to keep it from sliding off; and also a hole, 16 inches in diameter, in the center to put coal in; this plate was the top of the stove. There is no pipe on this stove, as none is needed, because if there was no sulphur in the foundry I think the moulders would never be satisfied.

This last week I made an addition to the stove, consisting of a boiler or reservoir for heating water for washing and other purposes. I have often noticed (as has many another old foundryman) that the men will take a pail of water and throw the head of a runner into it, not knowing or caring whether it is set in the middle, and, if it is not set when it is thrown in the water, off she goes, and there is an explosion; the pail is gone, and if they are spoken to about it, they say, "I did not know that it was loaded."

The boiler I made is three-quarters of a circle. I left the one-quarter of a circle out, to make it easier to put the coal in, as the boiler would not have to be moved. It is made thus: Take a 36-inch pulley pattern, lay it on a plate, get a 16-inch pattern and place it in the center of the 36-inch; then take two boards and place them in where you wish to stop it off, or, if desired, you can make it the whole circle. Make a core out of it as deep as you please, put some nice, fine cinders in, and vent it well, and bring the air out in the center of the top of the core. So much for the core; now for the mould. Dig up the floor and put in some boards to drive your chaplets in to hold up the core, make your bed and then put in the same patterns that you used for the core. Center them as you did for the core, and ram up the outside of the larger, and the inside of the smaller one; draw the patterns and drive in the chaplets; then put in your core, and if all right, you have thickness. Get two pieces and place against the end of the core, ram them up, get a piece of flat core, 8 inches in diameter, and place it on top of the core over the vent, so that the vent will go through and will make a hole to put the water in; fasten the core in its place, and then cast.

The other day a job came into the shop. It was a small spur gear, 1¼ inch face; it was wanted ¾ inch. I gave it to a man, Charles Reynolds, to make (I give his name, as I wish to give every man credit for what he knows). He asked me which way I wanted him to make it. I told him my way, and he said he thought he had a better way, and I told him to go ahead, as long as he made it good. So he had a frame made about two inches larger than the pattern and ¾ inch deep, beveled on the outside. He put his pattern on the follow-board with the frame around it, and rammed it up and made his joint up to the teeth, level with the top of the frame. Then he put a flask on the board around the frame and rammed it up, rolled it over, rammed up the top part of the flask, lifted it off, took his pattern out, wet around the frame, and lifted the frame out and stopped up the ¾-inch left in the bottom. He then put back his frame with the other ¾ inch and closed up his flask, and cast.

Here is another item that may be of use in some cases. We have been making extensive alterations and additions to our foundry, such as putting in new skylights, etc., and there was naturally a lot of glass in the old lights, that we thought of no use, as it was so begrimed with sulphur and dirt. It was laid aside. We tried to wash or scratch it off, but it was a failure; still I thought there must be some way of getting it off. I thought of some stuff that was left after pickling some castings. It was too weak for castings, but it answered first-rate for the glass, as it cleaned it perfectly. All I had to do was to wash it in water afterwards, and it looked like new glass.

THOS. WATHEY.

A feat in shipbuilding was accomplished on the Clyde last Saturday, in the launching of the North German Lloyd's Company's steamer, the "Dresden," from the yard of the Fairfield Shipbuilding and Engineering Company, Govan. This vessel, a steel screw steamer of 4,500 tons, 405 feet long over all, 46 feet 6 inches in breadth, 23 feet depth, was built in accordance with the newest regulations of the Germanischer Lloyd, under their special survey, in the unprecedented time of a little over 98 working days.—*The Mechanical World.*

Several explosions recently, of substances that have never before been known to cause an explosion, emphasize what appears to be a fact, viz., that when almost any matter is brought, by division and subdivision, to a condition approximating the gaseous state, it is, under favorable circumstances, likely to result in a disastrous explosion.

Old soldiers who read the papers will smile at the flaming account of a "terrible battle," in which the British troops were engaged at Suakim. The British troops stormed the redoubts and completely routed the rebels, losing four men. What a "terrible" battle it must have been, to be sure.

Condition and Prospects of the Machinery Business.

LETTERS FROM PROMINENT ESTABLISHMENTS TO THE "AMERICAN MACHINIST."

The Joseph Dixon Crucible Company (Crucibles, Graphite Paints, Pencils and Lubricants), Jersey City, N. J., write us:

The year 1888, which is closing, is chiefly notable with us for the large increase in the business of graphite specialties made by us, such as silica graphite paint, graphite pipe joint grease, graphite grease, and this verifies a prediction made by us years ago, that graphite would prove to be one of the greatest smaller articles in the arts. The total amount of business done by the Dixon Company in 1888 is larger than in any previous year. We have had to increase our plant by putting in one large new black-lead mixer, one large paint mixer, and one 100 H. P. steam boiler. We are heating a large portion of our buildings here by exhaust steam, having equipped for that purpose.

We see no reason why 1889 should not bring everybody in the United States good times. Where a nation of sixty million wide-awake, energetic people are gathered together under a million and one factory roofs, managed chiefly by younger men, educated in our best scientific schools, it promises good for the future.

The Shipman Engine Co. (Petroleum Engines), Boston, Mass., write us:

We are glad to be able to say that our business for 1888 has been particularly satisfactory to us. We have sold about one-third more engines in 1888 than in 1887, and find there is a growing demand for our engines wherever they have been introduced, not only in this country, but in foreign countries as well.

We have greatly increased our facilities for manufacture during 1888, and are able, at the present time, to turn out about ten engines per week at both of our factories, *i. e.*, at Rochester, N. Y., and Providence, R. I.

We have made no change in price since Jan. 1st, 1888.

We are, at the present time at work on drawings and patterns for compound and triple expansion engines, which will be placed on the market by March 1st, 1889. These, of course, are designed for marine engines, as there is a growing demand for compound and triple expansion engines for steam launches, and in order to meet this demand we have gone to great expense for drawings and patterns.

We have, within the past two months, established agencies at all the leading points West, namely: Detroit, East Saginaw, Milwaukee, Chicago, Minneapolis, Omaha, Sioux City, Dubuque, Davenport, Kansas City, Cleveland and St. Louis.

Our business outlook for 1889 is very flattering.

The Brown & Sharpe Mfg. Co. (Machinery and Tools), Providence, R. I., write us:

Orders during the year have been satisactory, and show a considerable gain in amount over 1887.

The works have run ten hours per day throughout the year. On the 1st of January 732 hands were employed, and the number has been gradually increased till 809 names are now on the pay-roll. During this year 51 machine tools have been added, a two-story, fireproof boiler and engine house, 51 x 98 ft., and a chimney 125 ft. high, connected with the brick building erected last year, have been built, and a Corliss steam engine with cylinder 16″ x 42″ put in.

Our universal milling and universal grinding machines have been the leading tools manufactured. By making them in large quantities with improved special tools for same, and keeping a stock on hand, we are able to supply our patrons promptly with tools of the best quality at reasonable prices.

Everything seems to indicate a prosperous business for 1889.

Hill, Clarke & Co. (Machinery), Boston, Mass., write us:

The amount of our business for 1888 has been very satisfactory in amount, although the margin of profit has been exceedingly close. It seems to us that business is unusually good just now, at the end of the year, so we are in hopes business will continue to be good after the first of January.

Pedrick & Ayer (Special Railway Tools), Philadelphia, Pa., write us:

We are very well satisfied with the amount of business done during the past year, and are particularly well pleased with our success in selling heavy universal milling machines. This is comparatively a new field for us; we have made strong claims for our machine, and every purchaser knows that we have substantiated them. We are very busy on orders for these machines and attachments. We have had a brisk trade in our railway repair shop tools, and in our general business have as much as we can possibly do.

We have purchased quite a number of new machines for our own use, and are employing more hands than ever before. Had we more room, we could use more hands to great advantage.

Inquiries for universal milling machines and our special tools for railway repair shops are coming in freely, and the outlook for 1889 is very satisfactory.

It is our intention to build our new machine shop next May, and then we will have ample facilities for handling heavy work, and completing our orders promptly.

William Tod & Co. (Engine Builders and Machinists), Youngstown, O., write us:

Our business in 1888 has been somewhat less in volume than in 1887. Prices of product have been lower, and materials have averaged a little lower. Labor has remained unchanged. We expect a considerable increase of business in 1889. Have added several new tools, and made some small additions to our buildings.

Darling, Brown & Sharpe (Machinists' Tools), Providence, R. I., write us:

Our business during 1888 has been good, and prospects for the coming year are encouraging.

The Worcester Machine Screw Co. (Set, Cap and Machine Screws), Worcester, Mass., write us:

We have had a good business all the year, an increase over any previous year, and the prospect for 1889 looks to us very flattering. There has been no change in prices of labor, product or material during the year, worthy of note.

Robert Whitehill (Corliss Engines and Ice Machines), Newburgh, N. Y., writes us:

Regarding your inquiry as to prospects, etc., for 1889, I am pleased to say at present I have large orders for engines and refrigerating machinery, and prospects for next year (1889) for additional orders, look exceedingly bright. I have recently shipped ice making machines to Australia, British Honduras, and am now building one of twenty tons' ice daily capacity, for Yucatan, Central America. Our foreign trade for the past year has been very good, and prospects for 1889 are unusually good. Home trade in engines and refrigerating machinery never was better.

The Lane & Bodley Co. (Corliss Engines and General Machinery), Cincinnati, O., write us:

We have turned out in the year 1888 a large product, but on very close margin of profit. We have made some changes during the year, enlarging our electric light plant, building a large lathe to turn 30 ft. diam., and generally increased our capacity for heavy work.

We have met, during the past year, with very fine success in the introduction of our Corliss automatic cut-off engine, in the cotton mills of the South. At the present time, foundry labor is slightly lower than it was at the closing of the preceding year, but in the machine shop there has not been much change.

We are favored in this section with cheap materials, but are not specially favorable to this condition, since we believe we make more money when all prices are on a higher plane.

We expect a more profitable year in 1889 than we have had in 1888, believing the development of the Southern trade will be the principal factor therein.

The Volker & Felthousen M'f'g. Co. (Steam Pumps), Buffalo, N. Y., write us:

Our business for 1888 has been much larger than any previous year; trade has decreased considerably during the past three months, but has improved somewhat since election. We anticipate a good, healthy growth in our business for 1889.

The Binghamton Hydraulic Power Co. (Oil Engines, Gas Machines, Water Motors, Elevators, etc.), Binghamton, N. Y., write us:

Business has been good; we have never laid our men off a day, and the prospects for future business are so bright that we have had a large building or factory, 4 stories high, 80 feet wide, 90 feet deep, with a basement, at 196, 198 and 200 State street, built for our accommodation.

We are now manufacturing water motors, elevators, the Richards oil engine, gas machines, and the Van Dusen barbed wire staple driver, and combined coffee mill and water motors.

Our goods are being introduced all over the world, and we have established agencies in almost every country. We look for a good trade next year, and hope to be able, one year from to-day, to report as favorably as now.

The Noroton Mfg. Co. (Saw Clamps, Experimental Work, etc.), Noroton, Conn., write us:

The saw clamps advertised in your paper were originally devised for our own use in the experimental work to which our machine shop has been chiefly devoted. The demand having steadily increased, they have been improved from time to time, and again quite lately, to fit them for rough work, such as sawing rusty iron into lengths for bolts, where considerable pressure has to be used, sufficient to break a saw stretched in a frame.

Inquiries and orders have come as well from all parts of this country as from Canada, India, New Zealand and Australia.

Pancoast & Maule (Pipe Cutting and Threading Tools, Glue Heaters, etc.), Philadelphia, Pa., write us:

We have been very busy this season, and have had quite as much as we could attend to during the last few months. While prices have been ruling low, the volume of business has been large, and we think all the indications point to an excellent trade in the coming year.

George B. Grant (Gears and Gear Cutting), Boston, Mass., writes us:

My business for the past year has been very good, and it shows its usual annual increase.

Having outgrown my city quarters, and requiring more room and better light than is obtainable in a great city, at a reasonable rent, I am building a shop in Lexington, Mass., and shall there do all my work, except my Boston jobbing. The shop will be eighty by thirty feet on the ground floor, with storage and stock rooms and wash-room in the second story, and with a detached boiler and forge house. It will be light on four sides, warmed by steam, and lighted by electricity. The expense would be ridiculously low for similar accommodations in the city. It is getting to be the general custom, and it is a good one, for Boston manufacturing concerns to move a few miles out of the city, and the increased accommodations and decreased expense more than balance the increased cost of transportation.

The new shop will be fitted with the most improved appliances and special tools for the making and cutting of gear wheels of every size and all descriptions. I intend to make it the largest and best appointed shop in the country devoted to my specialty, and shall be better able than ever to keep the quality of my goods up and the cost down.

The New Haven Mfg. Co. (Machine Tools), New Haven, Conn., write us:

In reference to your annual inquiry for particulars of our business, would say, the results for 1888 are very satisfactory. We continue to keep our works employed to their full capacity, and the prospects for 1889 are very flattering; and no doubt the general business of the country will be excellent, and in it all will have a share.

Curtis & Curtis (Die Stocks, Pipe Cutting and Threading Machinery), Bridgeport, Conn., write us:

The past year's business has been most satisfactory to us. Since July last our business has almost doubled, and the outlook for next year is very bright. This increase we attribute, in a great measure, to the great improvements in our machines that we have lately made. During the year we have built a large new factory, but even with our added facilities we have been pushed to the utmost to supply the demands of the trade for our pipe threading machinery. For six months past we have been running over-time, and are still behind our orders. We have added much new machinery, and are now negotiating for more. We are getting out and placing on the market a number of new sizes and styles of pipe threading machines, as fast as our already crowded works will allow.

The Curtis Regulator Co. (Engineering Specialties), Boston, Mass., write us:

In regard to the volume and character of our business, we are able to report a very satisfactory year. Although we nearly doubled our machine capacity in 1877, yet our orders have so steadily increased in volume, that we have been obliged to add 25 per cent. more to the total capacity of last year, and our facilities have been taxed to the utmost, to supply our regular demand from the trade all over the country and in Europe. We have now agencies in England, France, Germany and Denmark. We have brought out several new specialties within about a year: a combined separator and steam trap, an improved pump pressure regulator, and a balanced steam trap, all of which are meeting with much favor, and the future outlook is very promising.

Gould & Eberhardt (Machine Tools), Newark, N. J., write us:

Our business during the past year has been very satisfactory indeed, sales having increased about 30 per cent., with no material change in prices; but we have materially improved the standard of our tools. We anticipate a further increase in business during the coming year. We expect to further increase our facilities for turning out our patent automatic gear cutters, drill presses and shapers, with many small improvements, without adding to the cost prices of them, as fast as we can complete the arrangements for so doing. We have pleasure in reporting that we have taken several orders for shipments to Russia, Sweden, Belgium and Scotland, and other foreign countries, for our patent drill press and automatic gear cutters. Also have quite a call for our improved tools for the railroad trade.

The Bay State Iron Works, Noble & Hall (Steam Engines, Boilers, Hoisting Machinery, etc.), Erie, Pa., write us:

1888 has been the best year in our business since 1883. We have sold more large engines than in any previous year since we started business in 1864. We are making a specialty in large sizes, say from 50 to 200 horse-power. The worst drawback in engine and boiler making is the small margins. The rule for a number of years has been to see who could make the cheapest engine and boiler; we think that craze has seen its day, as people appear to be looking for better work instead of the cheapest that can be found.

Our ad. in the AMERICAN MACHINIST, of the Coates patent lathe attachment for turning crosshead pins, appears to bear fruit, and the fruit gives good satisfaction. We think the outlook for business another year is very favorable, and we look for better prices.

F. E. Reed (Engine Lathes, Hand Lathes, Foot-power Lathes, Milling Machines, Upright Drills, etc.), Worcester, Mass., writes us:

During the year 1888 I have added to my shop a building 44 x 58 feet, and three stories high. I have also increased my manufacturing facilities, by the addition of a number of new tools. I have done a fair business during the past year, and think there is a favorable outlook for 1889.

The Keystone Engine and Machine Works (Engineering Specialties), Philadelphia, Pa., write us:

In addition to our list of engineering specialties for steam power, such as pumps, feed-water heaters, etc., we have, during the past year, put upon the market with success two patented articles, viz: Simpson's centrifugal exhaust head, and Simpson's centrifugal separator for supplying dry steam.

We are supplying steam plants complete, and note an increase of orders for electric lighting purposes.

The Cleveland Twist Drill Co. (Twist Drills, Reamers, etc.), Cleveland, Ohio, write us:

Our business for the past year has been very satisfactory in every respect. We have been obliged, by pressure of orders, to enlarge our factory and add machinery, and have consequently moved into an entirely new building, 100 x 40 feet, 3 stories high, with an L addition 35 x 100, and have already added a number of new machines, and are building others as rapidly as possible. We hope in a short time to have all the new machinery in running order, when we will be able to practically double our capacity.

We have not noticed any change in prices either of material or labor during the year.

The past two months we have noticed a rapid falling off of orders, but believe it is only temporary, and that we shall have a large business in 1889.

The Frick Company (Engines, Threshers, Saw-mills, Horse-powers, Boilers, Ice Making and Refrigerating Machinery, etc.), Waynesboro, Pa., write us:

Our shops have been running full during the year of 1888, and with orders in hand and prospective, the outlook is good for the year 1889.

We are about completing an extension to our foundry, 120 feet long, 28 feet high, and have now ready for the roof; also a new erecting shop, which is 40 feet high in the clear by 314 feet long, besides adding several new large tools of the most improved makes, also other additions and improvements.

These additions to our works have been forced upon us by the growth of our Corliss

engine, and refrigerating and ice making machinery trade.

We are also introducing in our old foundry, in place of the old style jib cranes, power traveling cranes, each of 20 tons capacity, and similarly equipping our new foundry addition and new erecting shops. All these cranes are of a very substantial character, none less than 20 tons capacity, and of an approved design.

Our improvements will be completed in about six weeks, and we will be prepared better than ever before to take care of our growing trade in the lines mentioned.

In our other lines of trade, such as automatic engines, boilers, etc., business is satisfactory, and only choice orders are solicited.

The growth of our Eclipse Corliss Engine trade is specially surprising, considering the fact that, as yet, we have not attempted to push sales, they being simply made on their merits. Our facilities have been taxed day and night to fill orders in this department.

Our Eclipse ice and refrigerating machinery has pushed itself to the front rank, and is also growing beyond our facilities, further necessitating the additions mentioned above.

There are no marked changes in prices of labor or material. We are, to a certain extent, out of the current of main travel, but a visit to our works will convince anyone interested, that we are pushing abreast of the times in all essential things that tend to maintain our past reputation and keep our grip on the whip handle of the trade.

We believe and act upon the theory, "the survival of the fittest"; come and see us.

Vanderburgh, Wells & Co. (Printers' Materials, Pattern and Braud Letters, etc.), Paterson, N. J., write us:

Owing to the fire at our New York office, and to other causes, our progress this year has been quite limited. The manufacturing branches of the business have been quite brisk, and there is a good prospect that way for 1889.

Simonds Rolling Machine Co., Fitchburg, Mass., write us:

Our business has, up to within a few months, been largely experimental, and for the purpose of developing the Simonds patent process of rolling metal. Therefore we are not prepared to say much in regard to business previous to July of the present year.

We are now in shape to put on the market various standard articles rolled from steel, and are at present filling large orders for goods, for the Walter A. Wood Mowing and Reaping Co., Sterling & Girard Wrench Co., and others, and are making for the bicycle and other users millions of hardened steel, anti-friction balls. The volume of our business, as compared with last year, will be fourfold; we are receiving letters of inquiry and orders from every section of this country and several foreign countries.

The outlook for our business is certainly very good. We can see but very little difference in wages or cost of material.

The Bridgeport Boiler Works (Boilers, Heaters and Plate Iron Work), Bridgeport, Conn., write us:

We are able to report that we have been in the business swim through the past year and have kept out of the soup, for which we thank our patrons, who have given us nearly as much business this as last year, and with the exception of the summer months, our facilities have been fully employed, which was more than we expected in a presidential campaign year, and especially under such a radical difference of opinion on tariff duties. Therefore, we are very much pleased that our predictions for a poor year were not verified as we anticipated. As to prices and profits, we have to report a continuance of the same crazy competition, and consequently unremunerative prices to all who would give their just and reasonable profits to the buyer, who knows that he is not entitled to them, but, being human, will take them from whoever is foolish enough to give them; or whose unwise policy of increasing facilities compels them to fill orders at unremunerative prices. There are, however, indications of a wiser course in these respects, through the power of these same unremunerative prices and the desire of those who have had enough of them, to change to a more wise and remunerative policy, which will not only benefit the makers of steam boilers, but, in my opinion, will benefit the buyers as well; for it should not be forgotten that the makers as well as the buyers are human, and will endeavor to save all they can from unremunerative prices, in every possible way. An illustration of this probability was shown by the advice of a noted and competent steam engineer to his friend, who came to him to ask which of two proposals he should accept for the same specification for a boiler, the one at $800, the other at $1,000. The advice was, that he might suit himself, as in all probability he would get his money's worth from either party, and no more.

In a competition for a 150 horse power dome boiler against the offerings for horizontal tubular boilers, last month, we met the most degrading prices for the latter we ever saw or heard of, and from concerns who should stand somewhat upon their ability and dignity. There are concerns which do this, but generally they are ignored as being high-toned and high-priced, and the quality and reliability of their work is not taken into the consideration.

We were given the order for the dome boiler, however, because of the experience of the buyer with both kinds of boilers referred to. We have not had quite so much variety of work this as last year. It has been principally the dome boilers and feed-water heaters of larger sizes than last year; on the whole, we are satisfied with this year's business. In regard to the coming year's business, we believe that it will be good and more uniform than last year's, and better prices will be obtained generally. As an indication of this we have a call from one of our patrons (who is a free trader in raw materials and stumped for this during the campaign), for work, to be delivered and set up next July, and, as he has been very successful in business acumen, we feel safe in the above prediction, and hope it will be realized.

Montgomery & Co. (Tools, Supplies and Machinery), New York, write us:

Our business for the past year has been very good; have had all we could attend to. The outlook for the coming year is grand; collections are much better than a year ago. During the past year we have greatly enlarged our quarters, so as to enable us to carry a large and complete stock of the different tools dealt in by us. If business is only as good in 1889 as it has been in 1888, we shall be contented.

Cooke & Co. (Machinery and Supplies), New York, write us:

We are pleased to report that the past year has been a very satisfactory one. Although prices have been low, the volume of business has been large, and we have had gratifying success in advancing our specialties, such as Roots' blowers, automatic engines for electric lighting purposes, and wood pulleys.

At the present time we are making a good many estimates for parties who are enlarging their old, or building new works, and there is every indication that the coming year will be a busy one.

The Aerated Fuel Company (Devices for Burning Oil), Springfield, Mass., write us:

This company, during the past year, has been unusually successful in marketing its goods. It must be admitted that there is a growing desire on the part of manufacturers to obtain some other method of generating heat than by the system in general use to-day, viz., coal. We must also believe that the system which we own and control is perhaps successful in a very high degree in supplying this want, from the fact that we have done an unusually large year's work. It is also evident that manufacturers, after they have investigated on their part, are willing to believe that our system has merit and actual worth, from the fact that those who have been using the same in the past, are duplicating their original orders, and then, new ones are being continually received to that extent that now, in the almost dead of winter, we are so far behind on our orders that it will be some months before contracts can possibly be completed that are now on our books. The outlook for 1889 to us seems more encouraging than we could have anticipated or hoped for. It is gratifying to us to note that the country is in such a prosperous condition. In placing our system in different manufactories throughout the country, where we superintend the construction, we are enabled to see and note that the manufacturing interest seems to be booming; all concerns where we have visited are running full and over-time. We can only say in conclusion, that we wish you and all others the same success and encouragement which we are receiving for the coming year.

Charles R. Vincent & Co. (Automatic and Throttling Engines, Boilers, Heaters, Heating Apparatus, etc.), New York, write us:

We are very glad to know that you purpose continuing the admirable annual reports on the state of business, which it has been your custom to publish for so many years.

We are representing a number of prominent engine builders in this market, and from all we learn, their shops are running full. Our business in engines and boilers has been very satisfactory, and up to election time had no difficulty in keeping our books well filled with orders. Since then, however, there has been some falling off, and we observe a disposition on the part of buyers to wait until after the holidays before going ahead with improvements, etc., requiring new or additional power.

We anticipate an excellent business in engines and boilers in 1889.

Schleicher, Schumm & Co. (Engineers and Builders of the Otto Gas Engine), Philadelphia, Pa., write us:

Business has been fair until somewhat disturbed by elections, late in the year. We look forward to considerable increase, having prepared several new sizes of large engines, specially suited for electric lighting, in which gas companies now engage largely.

Beaudry & Co. (Duplex Power Press, Heating Forges, etc.), Boston, Mass., write us:

We have done very well the last year, as our machine is somewhat new, and we think the prospects for 1889 are very favorable. We are to open a new shop on the first of the year.

The Albany Steam Trap Co. (Return Steam Traps, Pumps and Pump Governors, Stop and Check Valves, etc.), Albany, N. Y., write us:

As a whole, our business has increased about 25 per cent. over 1887. Trade in return steam traps has been about the same—the Blessing renewable valves have given good satisfaction. Volume of trade about the same as last year. Our filter business has increased largely during the past year, with prospects of good trade in the future. We are now busy with a new automatic return pump and governor, for returning the water of condensation from heating pipes, brewers' kettles, etc.—supplied with exhaust or low pressure steam, reduced by means of reducing valves or throttling, and return the water direct into high-pressure boiler; this apparatus will be ready for the trade before the next heating season opens. We anticipate four years of good business.

The Billings & Spencer Co. (Machinists' Tools and Drop Forgings), Hartford, Conn., write us:

It is with pleasure that we report an increase of business for the year 1888. We have increased our plant during the year, both in the drop forging and machinery departments, and are running an increased force of help. Have doubled our facilities for the electric lighting of our factory and forge shops during the year. Business prospects for the succeeding year look to us very favorable at this time.

Fishkill Landing Machine Co. (Corliss Engines, etc.), Fishkill-on-the-Hudson, N. Y., write us:

The volume of our business during the past year shows a decided improvement over that of the preceding year, but margins have been very small. The outlook for 1889 seems promising, and we are hoping for increased sales.

There have been no considerable changes in prices of labor or materials.

Chas. A. Schieren & Co. (Belting and Lace Leather), New York, write us:

The demand for our special grades of belting, namely "electric" and "leather link belting" has been double that of any previous year. Our "electric" is still gaining favor with electric light users, and we predict a much larger trade in this article for 1889.

The demand for our leather link belting became so great that we were compelled to organize a separate company for its manufacture.

This concern, The American Leather Link Belt Co., have hired the five-story building at 46 and 48 Ferry street, and are now turning out link belting at the rate of twenty-five thousand square feet per year.

The most important event in our business during the past year, was the introduction of our new "electric perforated leather belting." During the month following the introduction of this belt, we sold it to no less than twelve different electric light companies.

We have also done a good business in lace leather. Our sales of "Brooklyn raw hide lace" have greatly increased, and we predict a good trade in lace leather during the coming year.

The Collins-Gibbons Mfg. Co. (Wire Machinery and Tools), St. Louis, Mo., write us:

Business has been most gratifying, considering the short time we have been in the market, and, judging from orders and numberless inquiries received from this and foreign countries, we are led to believe that the field for improved wire straightening and cutting machinery and tools is much larger than we had anticipated; we find that at least four sizes of automatic machines are required for all classes of work. Heretofore we have labored at a disadvantage, and passed a number of orders on account of being unable to supply the size desired. In the coming year we will fill all orders for tools, and will, about Jan. 1st, 1889, put in additional machinery and men for this purpose.

Jenkins & Lingle (Vulcan Cushioned Helve Hammer), Bellefonte, Pa., write us:

Our business during the year up to August was very satisfactory. Since that time it has been unusually dull. We expect to see things loosen up after January 1st, when books have been balanced, and everybody sees how it has been with them. The boom has certainly not struck our State to any great extent as yet. With the price of iron declining, business in Pennsylvania cannot be considered brisk in any branches.

The D. Frisbie Co. (Elevators, Stationary and Hoisting Engines, Clutch Pulleys, Cut-off Couplings, etc.), New York, write us:

In answer to yours of 19th, we have to say our business has been good for most of the time the past year, although prices have been lower than last year. We have enlarged our shop about one-third, with the view of paying more attention to elevators than formerly; we have brought out several new patterns this year, and hope by good work and close prices to receive our share of the business offered. We are prepared to furnish direct steam hoists, or spur-geared friction clutch, or worm-geared shifting belt machines; cars of the most improved safety device.

Trump Bros. Machine Co. (Light Machinery, Finished Hexagon Nuts, Set and Cap Screws, Stud, Coupling and Tap Bolts), Wilmington, Del., write us:

We are pleased to report a very satisfactory year's business for 1888, and, as far as 'tis possible "to gamble on the future," the prospect for 1889 is most promising.

We have added several new tools during the year, and *think* we have improved our methods in facilitating work, but have not increased our plant in the way of buildings.

We are paying more for both material and wages than we did in 1887, while we are furnishing most of our products for lower prices than we received during 1887.

In finished hexagon C. H. nuts, our trade is constantly increasing, and we have added to our facilities commensurately; we make a specialty of this line.

Our sales of "Trump chucks" have been most gratifying—"away ahead" of any previous year.

In knitting machinery, we have brought out several new features for the patentees, and in this line we are constantly making improvements—which seem to be appreciated, judging from sales. We have averaged full time for the year.

To sum up: we are satisfied.

American Standard Gauge and Tool Works (Makers of Implements for Standard Measurements), Wilmington, Del., write us:

The amount of business done in 1888 has been larger than any year since 1882. The number of men employed has been increased during the year, and additions have been made to grinding machinery and small tools. Several full sets of gauges were shipped on orders to England, Australia and Canada, and we have now (December) inquiries from France, Germany, Italy and Scotland for these tools. Some gauges as large as 10¼ inches have been furnished in this country.

The manufacture of shell reamers, up to 5 inches diameter, begun in August last, has been a success, and we hope to make them up to 10" or 12" before the end of 1889.

There has been a large increase in inquiries for tools of accuracy from all quarters, and there is no doubt that, not only the large shops, but also the small ones, are getting to be fully alive to the importance of interchangeability of parts in the manufacture of all kinds of machinery. There is every reason to be satisfied with results this year, and indications seem to promise increase of business with the new year.

James Leffel & Co. (Steam Engines and Boilers), Springfield, Ohio, write us:

Our sales of steam engines and boilers in 1887 were largely increased over the previous year, and our trade in 1888 is greatly in excess of last year. The outlook for 1889 is such as to warrant us in arranging to meet a still larger demand. We have for many years enjoyed a large trade in small upright engines and boilers, to which we have added a line of horizontal engines and boiler, up to 26 horse-power, which, we are pleased to say, have been received with great favor thus largely increasing our trade.

Boynton & Plummer (Machine Tools), Worcester, Mass., write us:

We have to say that business has been quite satisfactory to us during the past year.

(Other letters will appear next week).

AMERICAN MACHINIST

To prevent delays all Communications should be addressed to the Company.

PUBLISHED WEEKLY
BY
American Machinist Publishing Co
96 Fulton Street, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
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☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once.*

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$2.50 a year in advance, postage prepaid in the United States, Canada and Mexico.
$3.50 a year to Other Countries, postage prepaid.

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Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
The International News Company,
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NEW YORK, JANUARY 3, 1889.

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The Machinery Trade.

Following our usual custom at the beginning of the year, we publish elsewhere in this issue letters from a large number of representative machinery manufacturers and dealers. We invite the attention of our readers to these letters, as giving a good idea of the condition of the machinery business of the country; much better than could be conveyed in an essay on the subject, however carefully prepared.

It will be noticed that many of these letters tell of enlargement of works and the employment of more men, with a corresponding increase in the volume of business done. The conclusion seems inevitable that there has been a healthy increase in the machinery business during the year 1888. Nothing like a boom, but a gradual increase that has more than kept pace with the growth in population.

In some instances there is complaint of low prices; it is undoubtedly true that prices have ruled too low, but manufacturers seem inclined to meet this condition by improving their methods of manufacture rather than by an effort to increase prices.

There has been but little change in the cost of material, and wages appear to have remained without change.

The burden of opinion, as expressed in these letters, is that the year 1889 will be a good one for those who make and sell machinery. We hope and believe this will be the case.

One Cause for the Difference.

In conversation the other day with a man who is engaged in the manufacture of pocket cutlery, a subject was mentioned which throws some light upon the underlying or prime reason for the difference which every one observes between the methods of manufacture in this country and those pursued in England.

It was incidentally mentioned in the course of conversation that about all the men employed in the factory were Englishmen, who had worked at the same business before coming here; and, upon asking the reason for this, we were informed that it was because native Americans, possessing sufficient skill to forge good knife-blades, could not be induced to keep on forging them; for, as soon as they acquired sufficient skill to forge a knife-blade properly, they wanted to do something else, while an Englishman, having learned to forge knife-blades, apparently never thought of doing anything else, and was perfectly satisfied to forge knife-blades in the best possible manner all his life.

It is altogether likely that it is this difference in the disposition of the workmen of the two countries which, more than anything else, accounts for, and is the cause of the different methods which are followed in the two countries in the manufacture of the same things.

The older manufacturing country has evolved a class of men whose fathers and grandfathers before them followed the same pursuit which they now follow, and in much the same manner: whose highest ambition it is to continue on in the same line, and to transmit to their children their inherited and acquired skill, that they in turn may follow the same pursuit.

Indications are not lacking that the same process of evolution will take place in this country in the future; but as yet there seems little tendency in that direction, the most of our monotonous and narrowly restricted occupations being followed by men who have learned to be satisfied with such pursuits in foreign countries.

The native American no sooner learns to do one thing well than he is possessed of a strong desire to learn to do something else equally as well, and something requiring a somewhat higher grade of skill. As opportunity offers, he will make his occupations continually progressive; often, it must be confessed, allowing his ambition to carry him forward somewhat faster than is entirely consistent with thoroughness. There is something about the constant and unvarying repetition of identically the same operations in the same manner, hour after hour, day after day, and year after year, which is unspeakably wearisome to most men, and, indeed, we believe that very few men of their own free will continue to follow such pursuits, unless, as in the case of the knife-blade forgers, the natural disposition of man to develop, to progress and to seek variety, has been in some way suppressed.

This has been done in England by generations of hard social conditions—conditions which afford comparatively little ground upon which men can base reasonable hopes of rising above the station in life to which they are born. That this condition of apathy, and lack of ambition to progress toward higher things, is not natural, is proven by the fact that the children of men who are perfectly satisfied to spend their lives in forging knife-blades, when born and brought up in America, where as yet the opportunities for the gratification of ambition are much greater, are as ambitious, and usually as successful, as those whose ancestors for generations have lived in this country. It is this dislike of monotonous occupations, and the universal ambition to rise above them, which, probably more than any other cause, inspires the invention of the wonderful labor-saving machinery for which America has become famous, and causes to be done by machinery what in other lands is done by manual labor.

Villainy and Heroism.

The depths of black-hearted villainy to which men can descend, and the exalted heroism and self-sacrificing devotion to duty which they are sometimes capable of, were both shown in a wreck which occurred on the St. Louis & San Francisco Railroad, December 18. Train wreckers had removed some switch bolts and spread the rails, with the intention of throwing the Texas express train over an embankment. A fearful loss of life was averted only by the fact that the express was preceded by a wild engine, upon which was a hero. The engine was wrecked, and the fireman, with his ankle broken, and suffering sufficient pain to unnerve most men and make them oblivious of everything else, remembered his duty, and that a train bearing two hundred people was behind, dashing on towards destruction. Dragging himself back over the track for more than a mile, he flagged the train, thereby showing that he not only knew what to do in an emergency, and under exciting circumstances, but that he was hero enough to do it when disabled and suffering to such an extent as might well have been taken as a valid excuse for failure. We regret that we have not the name of the man, of whom humanity has reason to be proud.

The Care of Steam Engines and Boilers.

The World favors us with the following:

Can you give this correspondent the information he desires, and thereby greatly oblige?

The correspondent referred to asks of *The World* as follows:

To the Editor of The World:

Will you please tell me through the columns of your paper where I can get a book on the care and management of steam engines and boilers, such as are used by portable and stationary saw mills, and other machinery of the kind?

Recognizing that too little practical information has been published on this subject, we have procured the preparation of a series of articles on "The Modern Steam Plant and its Management," the first of which appeared in our issue of December 20, 1888. These articles will be continued, to cover all the points *The World's* correspondent is interested in.

We regret to say that no book yet published will give this correspondent the information he is looking for.

The time seems to have arrived when the formation and management of trusts, combines and corners must be recognized as one of our leading American industries. A good many men devote their entire time and talents to it, and the results of their labors are becoming more and more apparent day by day. There now remain comparatively few articles consumed by the people, the prices of which are not affected or entirely controlled by some sort of an organization, the object of whose existence is to interfere with the natural laws of trade.

Man cannot persistently ignore and trample upon nature's physical laws without paying the full penalty. This cornering business will probably go on until the people perceive at last that they are themselves cornered; then something will happen, and the corners will begin to pay their share of the penalty.

Literary Notes.

We have received *The Technic*, published annually by the Engineering Society of the University of Michigan. It contains some excellent articles, amongst which we notice one on "Cements," another on "Long Distance Distribution of Electric Energy"; one on "Blue Printing," "The Ventilating of Houses," etc. There is also a paper by Prof. M. E. Cooley on "Dynamics of Reciprocating Engines," in which the subject is very fully gone over. Not the least interesting part of the contents are the cuts and description of the engineering laboratory.

PLATE GIRDER CONSTRUCTION. By Isam Hiroi, Assistant Professor of Civil Engineering in Sapporo Polytechnic Institute. Formerly Assistant Engineer in Edge Moor Iron Company.

This little book is another addition to Van Nostrand's Science Series. The aim of its author is to present, in as simple a manner as possible, a somewhat rational mode of designing girders of this class, with special reference to American practice. The subject is treated in a clear, concise manner, fully illustrated, giving ground principles, and formulas which are to be applied in the construction of plate girders. These formulas are then applied to a practical example, in which all details of a single track, standard gauge girder of 50 feet span, are worked out, and clearly shown in a working drawing. In the conclusion of this subject the actual weight of the girder, with the estimate of its cost, are given. We believe that this little volume cannot fail to be interesting, instructive, and highly valuable to beginners in bridge designing, draftsmen and others engaged in the construction of plate girders. The book is published by D. Van Nostrand, 23 Murray and 27 Warren streets, New York. The price of the book is 50 cents.

The Christmas number of *The Journal of the International Brotherhood of Machinery Moulders* comes to us in enlarged form, with the motto of "Still Onward and Upward." We are more than pleased to note the steady progress made by the *Journal*.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(1) J. W. M., Fayetteville, Ark., asks: Which is the correct name for the ball or riveting end of a machinist's hammer—pene, pane, or pein? *A.*—We cannot say. Webster is silent upon the subject, and other writers differ. We prefer pene.

(2) J. H. H., Newark, N. J., asks: Is the efficiency of a pump increased or diminished by a loose fitting water piston? *A.*—By a loose fitting piston we understand you to mean one that leaks. With this understanding, we should say the efficiency is diminished.

(3) E. A. S., Norwich, Conn., asks: Is there anything in the line of a pencil for marking on iron, which is better than the common slate pencil? Where can such be obtained? *A.*—Some boiler makers prefer soapstone to the ordinary slate pencil. You can obtain it in any boiler makers' supply store.

(4) W. A. J., ———, Cal., asks: Will you please give me the weight of the largest anvil in the world, when and where cast, and how long it took to cool to the center? *A.*—We do not keep a record of such castings. Probably some of our readers can furnish the information.

(5) C. E. C., New York, writes: Will you kindly inform me in what book or paper I can find a description of the building of the modern locomotive in detail. Have always wanted to make an attempt to construct one, but have not been able to find a scale drawing. *A.*—You will find a general plan of an eight-wheeled locomotive drawn to a scale in our issue of January 10, 1885. As for details, you will find these in the articles on Modern Locomotive Construction, now running in the AMERICAN MACHINIST. All the illustrations given in these articles are drawn to a scale.

(6) J. D. P., Canada, asks: 1. If the cold weather or other causes split a locomotive feed pipe made of copper, how can the broken places be mended? *A.*—If the split is in that part of the feed pipe which is not subjected to any pressure, then mend by soft soldering. If the split is in that part of the pipe which is subjected to a pressure, then braze on a piece of sheet copper. 2. How do the boiler makers make a joint with cast-iron borings? *A.*—Take the cast-iron, 200 parts; sal-ammoniac, 2 parts; and flower of sulphur, 1 part; mix with water to a thick paste, and drive it into the joint. What is the cause of steam pump losing its charge? *A.*—It may be caused by a leak, or by the attempt to lift the water from too great a depth.

(7) J. C. B., Great Falls, Montana, writes: We have several 5-inch expansion joints on one of our steam lines. What is the best packing to use in them to make them tight and lasting? *A.*—Hemp packing is good; or you may use any of the packing made for the purpose and sold by responsible dealers. 2. We have an 8-inch whistle, with 2-inch steam connection Can we attach anything to increase the sound? What we are after, is noise, and lots of it I have heard that a plate of steel, similar to a circular saw, would add to the effect. *A.*—We do not believe that any kind of attachment to a well-constructed whistle will increase the noise very perceptibly. If you want more noise, and lots of it, either increase the size of the whistle, or increase the number of whistles.

(8) C. C., White Oaks, New Mexico, sends us two sketches of a rope and pulley. In one sketch a rope is passed over a pulley; a weight is attached to one end and the power is applied to the other end of the rope. The second sketch is like the one just described, but instead of applying the power directly to the rope, it is applied by means of a lever. He asks: Has a large pulley any advantage over a smaller one? *A.*—The large pulley has a slight advantage over the smaller one; namely: with the larger pulley the effect of the friction of the pulley on its pin will be reduced, consequently the power necessary to overcome the friction of the large pulley will be less than that required for overcoming the friction of the smaller one. Another advantage is that, with large pulleys, a rope will last longer than with smaller ones.

(9) A. B. C., Frankfort, N. Y., writes: Will you please inform me the cause of the so-called three-cornered exhaust in mogul engines? Is it the valve setter's fault? or is it so with all mogul engines? I have been told that there is always an unevenness in the exhaust of this class of engines, but I cannot perceive the truth of this statement. *A.*—All good mogul locomotives have an even exhaust, the same as is found in all other well-built locomotives, and no good reason can be given for different results. An uneven exhaust indicates that the engine does not cut off square, and this may occur either through inaccuracies in setting the valve gear, or a faulty design of engine. If the trouble is caused by the design, the fault may generally be found either in the position of the saddle pin or the position of the lifting shaft. It may also be caused by an unequal inside lap.

(10) A. H. H., ———, writes: When I first entered the boiler room of which I have charge at present, I found the feed pipes connected in a manner which caused me to examine the boilers very closely. I found the upper rows of tubes in a state which seemed to indicate that they had been burned, and led me to believe that the manner in which the feed pipes were connected caused all the trouble. There are two boilers which we will call *A* and *B*. The arrangement of the feed pipes is such that, in opening a valve to blow off *B* only, it may happen that *A* will also be blown off instead of being fed. Now, is this a good arrangement? *A.* No; there should be no connection between the feed and blow-off pipe. 2. I saw a boiler placed in position with its rear end in front: that is to say, the boiler had the steam drum close to one of its ends, and instead of placing the boiler so as to bring the steam drum over the grate, it was placed so as to bring the drum away from the grate. Is this a good way? *A.*—We prefer to have the steam drum in the center of the boiler; but if the drum has been placed near the end, we should place the boiler so as to bring the drum away from the grate; in this position, priming is not as liable to occur as with the steam drum directly over the fire. 3. Where can I obtain during the day-time a theoretical education in steam engineering? *A.*—Write to a technical institute which is nearest to your place of business, or procure a private teacher. You may also obtain this education at home, by procuring and studying good books which treat on this and kindred subjects.

(11) W. S. L., Battle Creek, Mich., writes: I have had very poor success in selecting books from the titles in catalogues; such titles are often misleading. Indeed, I have always been disappointed with such purchases. What elementary geometry would you recommend to a man who is not acquainted with algebra? *A.*—You can study elementary geometry without a knowledge of algebra: indeed, elementary geometry should be studied before algebra. There are so many good geometries in the market, that it seems to us to be almost impossible to make a poor choice. Our limited space prevents us from specifying all of them, and to mention only a few of them may be unjust to other authors. But we will say this, that we have used Davies' Legendre, and E. Loomis' Elements of Geometry. 2. What work on mechanical laws? I want an explanation of the principles of mechanics. Also, what algebra and natural philosophy could you recommend? *A.*—Elementary Algebra, by Charles Smith, is good. When you have made considerable progress in this study, take up Practical Mechanics, by John Perry; and also Theoretical Mechanics, by J. E. Taylor. The foregoing books are not expensive; probably none of them will exceed a price of two dollars. As for natural philosophy, there are so many good ones, that you can hardly fail to make a good choice, particularly if you are willing to pay six dollars and upwards for one. Those at a smaller price may, and may not, be satisfactory to you, although, if the latter, it may not be the fault of the book.

(12) Apprentice, Brooklyn, asks: 1. How can I determine the saturation of steam? And where can I obtain a description of the instruments used? *A.*—See AMERICAN MACHINIST, Sept. 17, 1887. 2. What boilers are used on the new cruisers for U. S. N., and where can I get a description of them? *A.*—Write to the Chief of the Bureau of Construction and Repair, Washington, D. C. 3. In what number did the articles on marine engines, by W. H. Hoffman, begin? *A.*—March 24, 1888. 4. Can a young man studying the papers on Practical Drawing by J. G. A. Meyer become a draftsman fit to enter a drawing-room? *A.*—Yes. A person studying these articles thoroughly, as they appear in the AMERICAN MACHINIST, will be able to make a correct drawing of any object or machine. 5. In what number did you describe the setting of the Corliss valve gear? *A.*—Feb. 27, 1886. 6. In what number could I find a description of the Corliss valve gear? *A.*—Nov. 20, 1886. 7. How can I get the proper diameter for a feed pipe for boilers? *A.*—Divide the diameter in inches of the pump plunger by 20; multiply this quotient by the square root of the mean velocity in feet per minute of the plunger; the product will be the required diameter of the feed pipe. Or, if d is the diameter of the plunger, and S its mean velocity in feet per minute, then $\frac{d}{20}\sqrt{S}$ = diameter of feed pipe. Example: The diameter of the plunger is 3 inches; stroke, 18 inches; the pump is attached to an engine making 60 revolutions per minute; what should be the diameter of the feed pipe? Here S (the mean velocity of the plunger) $= 1.5 \times 2 \times 60 = 180$ feet. Hence, diameter o $\frac{3}{20}\sqrt{180} = 2.01$, say 2 inches. If the plunger is 6 inches diameter, or greater than this, then, instead of $\frac{d}{20}\sqrt{S}$ use $\frac{d}{23}\sqrt{S}$. In general, the feed pipes should be such that, for small pumps, the velocity of flow does not exceed 400 feet per minute; and for large pumps, the velocity of the flow does not exceed 500 feet per minute.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Gear wheels and g-cutting. Grant, see adv., p. 16.

Link Belting.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Machinery Co., Chicago and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

The Best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Drop presses, punches and shears. Williams, White & Co., Moline, Ill., manufacturers.

"Swift" Sight Feed Lubricator; no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.

Davis Key-Seating Machines kept in stock by Manning Maxwell & Moore, 111 Liberty st., N. Y.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Brown & Sharpe Mfg. Co. have a line of machinery with S. A. Smith, 23 S. Canal st., Chicago, Ill.

Dynamos, Engines, etc., need Common-sense oil filters; great saving. C. F. Baker, Minneapolis, Minn.

Ice and Refrigerating Machines, 131 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Mechanical drawing and designing taught by correspondence. I. Donald Boyer, Dayton, Ohio.

The Waterhouse Electric and Manufacturing Co., Hartford, Conn., have a steady arc light for factory lighting.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Automatic Wire Straightening and Cutting Machinery, Tools, etc. Manufactured by Collins-Gibbons Mfg. Co., St. Louis, Mo.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Upright drills, improved, sizes 21", 23", 25", 28" 32", 36" swing; finely made and great capacity. Currier & Snyder, Worcester, Mass.

Patents obtained. Patent litigation conducted R. G. DuBois, Patent Attorney, 928-930 "F" street, Washington, D. C. Correspondence invited.

Send for Descriptive Catalogue of "Roper's Hand Books" for engineers and firemen. Edward Meeks, Publisher, 1012 Walnut street, Philadelphia, Pa.

Most sensitive and durable Damper Regulator made; works within one pound; send for circular. T. Kieley, 11 W. 13th st., New York.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Dec. 1, p 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Fine tools and supplies for machinists and other metalworkers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., N. Y. City.

See illustration of improvements in Hooks for Steam Engines, in Nov. 24 issue. For particulars address T. C. Dill Machine Co., 726 Girard av., Phila. Pa.

With my System, Exhaust Steam Heating costs nothing for fuel; Live Steam Apparatus altered to Exhaust. Satisfaction guaranteed. Geo. A. Barnard, 15 Cortlandt street, New York.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing gray iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.

The Vance Lightning Flue Cutter is *the* tool for removing old flues from boilers and locomotives (will cut fifty an hour); sent on approval to railroad companies. Vance Tube Cutter Co., Geneva, N. Y.

"Curiosities of the U. S. Patent Office." Just out. Unique, Entertaining, Instructive, Amusing. An Elegant, Illustrated, Cloth-bound book. Price, $1.50. Descriptive pamphlet *free*. Wm. C. Raymond, Publisher, Syracuse, N. Y.

A system of easy lettering, by J. H. Cromwell giving 26 forms of alphabets. The space to be lettered being divided into squares; simple and effective. Price 50 cents. Catalogue of books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N. Y.

Special facilities for the manufacturing of all kinds of light machinery, hardware and novelties, by contract or otherwise. Presswork and stamping done on short notice. Estimates furnished. Punches, dies and special tools made when required. Rockaway Mfg. Co., 3 E. 14th street, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

"Practical Drawing" By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including Dec. 15, 1888 issue 65 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 80 articles have thus far appeared up to and including the Dec. 20, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES

J. B. Morrell will build a flour mill at Bryson Tenn.

The Globe Iron and Brass Works will erect buildings at Sheffield, Ala.

The Camden (Maine) Woolen Mill is increasing its capacity 33 per cent.

Guil & 'Bumiller will build a machine shop on Willow street, Chicago, Ill.

D. B. Carson is interested in building an electric light plant at McMunnville, Tenn.

The Georgia Pacific Railroad will add more tools to their shop equipment at Columbus, Miss.

An electric light plant will be erected at Annapolis, Md., by the Annapolis Electric Light Co.

The factory of the Central Furniture Co., at Cincinnati, Ohio, was recently destroyed by fire.

The Ette & Henger Manufacturing Co., St. Louis, Mo., have just completed a new foundry, 60x60 feet.

The Great Western Steel Rolling Mill and Steel Wire Company are to build works at Kansas City, Mo.

The Montreal Rolling Mill Company, Montreal, Can., have decided to enlarge and improve their mills.

Lewis & Hyde, Pittsburgh, Pa., are interested in forming a company for making crystallized and decorated tin plate.

The Spanish Moss Manufacturing Company are building a factory at Fort Worth, Texas, for making jute bagging.

A. T. Barclay, C. M. Figgat, C. W. Irvine, and others contemplate erecting an electric light plant at Lynchburg, Va.

William E. Montague, of Philadelphia, will soon start his worsted machinery, which has been idle for some time past.

The old butt weld mill of the National Tube Works, at McKeesport, Pa., will undergo extensive repairs during the holidays.

W. Asquith, machine tool manufacturer, Halifax, England, writes us that he has lately shipped some of his tools to San Francisco, Cal.

A new foundry is being erected at McKeesport, Pa., by George Russess E. H. Leezure and others, and will soon be ready for operation.

The Ohio Valley *Manufacturer* states that at the Riverside Mill, Wheeling, West Va., a recent change eliminates natural gas from the entire plant.

Work is going on in the construction of the bolt and nut works of Mr. John White, in London, Ont. They are expected to be in operation in January.

Perkins & Co., Grand Rapids, Mich., are building an addition to their shops, 75x90 feet, three stories high. They build machinery for making shingles.

The new steel plant of the Phœnix Iron Company, Phœnixville, Pa., has begun operations. This company propose to make steel heavy enough for armoring government cruisers.

The Rockland (Maine) *Courier-Gazette* understands that the owners of a good water power at South Liberty would give the power to anyone who would build a mill of any kind worth $1,000.

The Emerson Manufacturing Co. of Lawrence, Mass., are to erect a new shop 150x40 feet, and one story high, for the manufacture of paper making machinery. The new shop will give employment to 25 men.

The Battle Creek (Mich.) Machine Company are putting on the market the Marsh steam pump for boiler feed. The pump, which weighs only about 20 pounds, will be manufactured by the use of special machinery.

Arthur King, 38 Gold street, New York City, has taken the place formerly occupied by The Kelley & Jones Company, Erie and 11th streets, Jersey City, N. J., where he intends to carry on an extensive foundry and machine business.

James Chadwick & Brother, of England, have rented part of a new organ factory in Bridgeport, Ct., to finish cotton threads imported from England. They will occupy 15,000 square feet of space, and hope to begin regular work by January 1.

The McFadden Co., Philadelphia, Pa., have issued a new catalogue of supplies and cutlery handled by them. The catalogue contains more than 1,000 pages, and embraces most everything used in the way of manufacture. The catalogue is very fully illustrated.

It is said that the capitalists who are moving for the erection of a new cotton mill at New Bedford, Mass., will begin building operations in the spring. They have bought ten acres of land, and there is a capital of $300,000 or $400,000. A variety of cotton goods will be manufactured.

Jones & Laughlins, Pittsburgh, Pa., have contracted for the iron work to be used in the new Chamber of Commerce at Chicago. About 15,000 tons of steel beams, wrought-iron girders, and other wrought-iron and steel work will be required. The whole contract will amount to something over $500,000.

H. D. Stratton & Co., Columbus, Ga., write us: "We are now erecting one of our latest improved ice-making machines at Ironton, Ohio. This we think is returning the compliment, when the South sends her machinery to make ice for the North. Our machines will make six tons of ice for each ton of coal burned, thus showing how cheaply ice can be made."

The National Electric Light & Motor Co. has been incorporated at Victoria, B. C., with $100,000 capital. The objects of the company are the generation and sale of electricity for light and power, the construction and working of tramways, and the manufacture and sale of electrical goods of every description. The head office of the company will be at Victoria, where work shops will be erected.

W. P. Davis, North Bloomfield, N. J., well known to our readers as a manufacturer of key-setting machines and other specialties, will extend the scope of his business by opening offices at 169 and 171 Mill street, Rochester, N. Y., where he will handle a full line of machine tools and supplies; also engines and boilers. Mr. Davis has been traveling West, and has made most gratifying sales of tools he represents. He is particularly impressed with the business prospects for next year. All the enterprising dealers, he says, report good sales and excellent prospects; only the small dealers, and those who do not keep abreast of the times, anticipate dull times.

A press dispatch says: Fire broke out in the boiler room of the P. Lennox Morocco Factory corner of Market street and Harrison court, Lynn, Mass., and resulted in the most disastrous conflagration that has visited that city for a year. The factory was a large four-story brick and granite building, built comparatively recently at a cost of $60,000, and this was completely destroyed, together with the machinery, valued at $60,000 more, and valuable stock. A four-story wooden building in the rear, belonging to P Lennox, and occupied by Harvey Brothers, morocco manufacturers, was also burned, as was the adjoining two-story wooden building containing the boiler.

Machinists' Supplies and Iron.

New York, Dec. 27, 1888.

Iron—American Pig.—Trade has remained in about the same condition since our last report. The demand for next year's deliveries has been fairly good, and some orders have been booked at present quotations. The demand for manufactured iron has not been altogether satisfactory. We quote standard brands, No. 1 X foundry, $18 to $18.50; No. 2, $17 to $17.50; Grey Forge, $15.50 to $16.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 90 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—See bottom of third column, page 11.

Machinist wanted—first job hand capable of managing small shop. J. H. Wells, Tampa, Fla.

Wanted—A brass moulder who can make solid castings. Address B. C., care American Machinist.

Machinist, willing to give fair test of not common ability, wishes position. Address P. American Machinist.

Young machinist and draftsman wants position where he will have some out-door exercise. Address Box 58, American Machinist.

Practical machinery moulder wants shop to run by the ton, or will take job on floor; sober and steady. Foundry, Box 115, Ballston Spa, N. Y.

Machine shop foreman wants charge; well up in modern practice; handle men to advantage. Contract or otherwise. Address Practical, Am. Mach.

Position wanted as draftsman, experienced in iron structural, bridge and architectural work; also in general mach'y. Best ref. R. V.; Am. Machinist.

Wanted—Experienced foreman of machine department; will have charge of 50 men; state experience, age, references, and wages expected. Bucyrus Foundry & Manufacturing Co., Bucyrus, Ohio.

Young man, machinist, wants position; accustomed to machine tool repairs, to milling and cutter grinding, lathe or planer work; can draw or design if required; sober, steady. Box 73, Am. Mach.

Wanted—A young man as assistant draftsman, preference will be given to one having some experience with Corliss Engine details, and a graduate of Stevens, or other similar institute. Reply, stating age, experience, and salary expected. Address Robert Whitehill, Newburgh, N. Y.

Wanted—A first class machinist as assistant foreman in our shops; only those thoroughly familiar with the manufacture of wood-working machinery need apply. A young man who is smart, energetic and ambitious preferred. A good opening for right man and good prospects for future advancement. Address E. & B. Holmes, 59 Chicago st., Buffalo, N. Y.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Gerlach's Engineers' specialties beat the world. Send for price list. Crescent Mfg. Co., Cleveland, O.

Crescent grease cup for shafting beats them all. Sample free. Crescent Mfg. Co., Cleveland, Ohio.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

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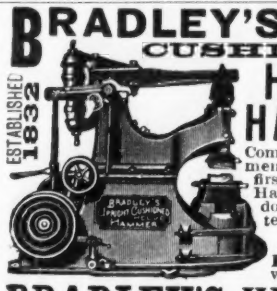

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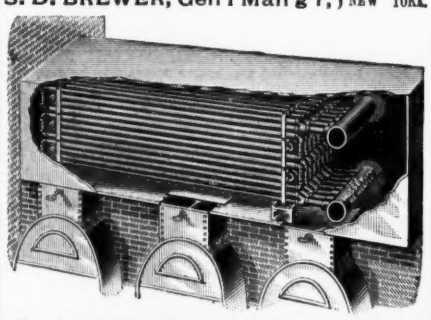

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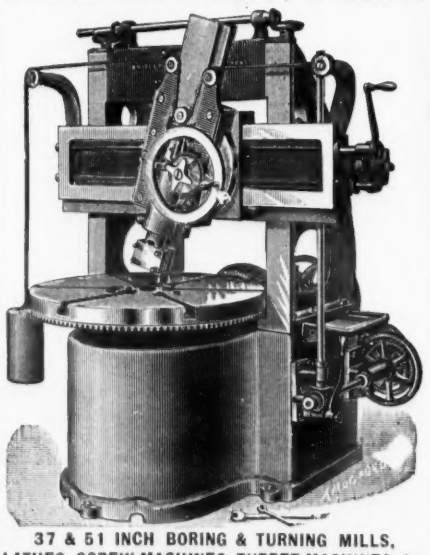

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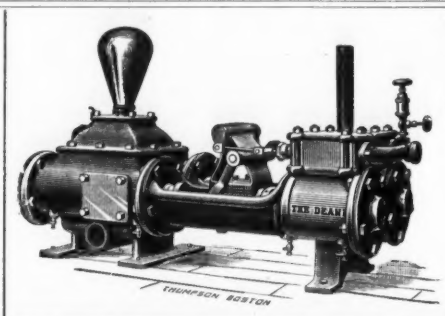

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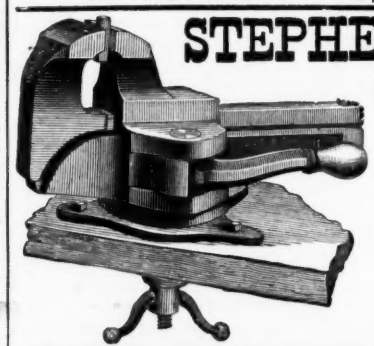

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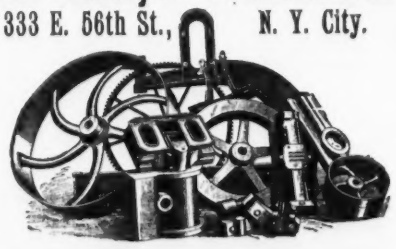

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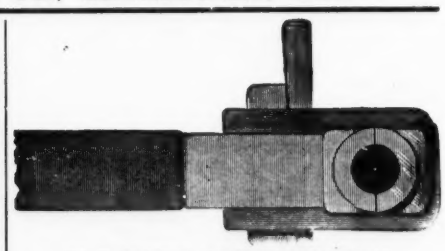

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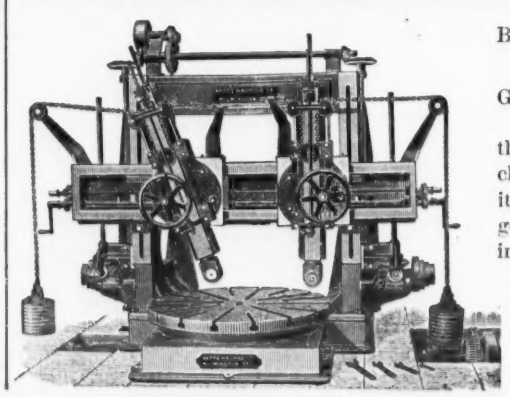

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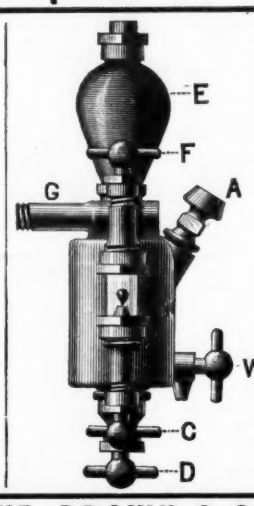

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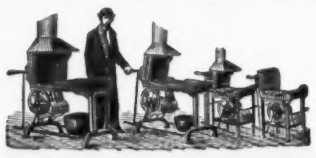

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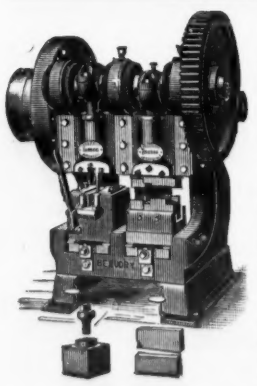

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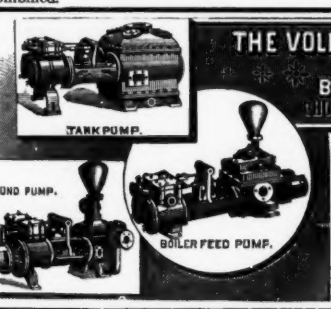

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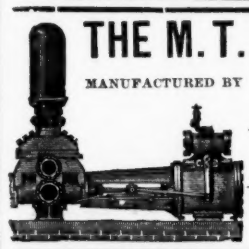

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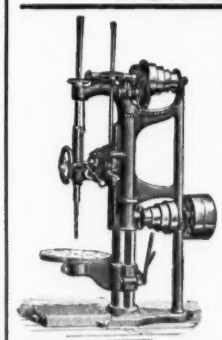

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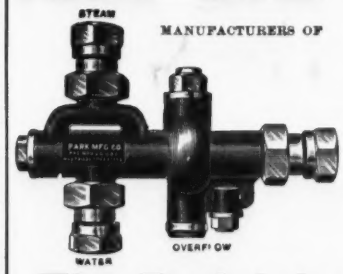

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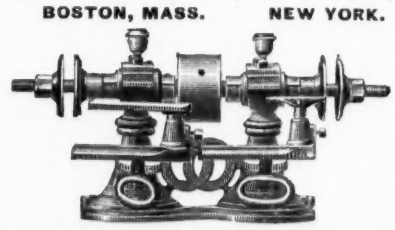

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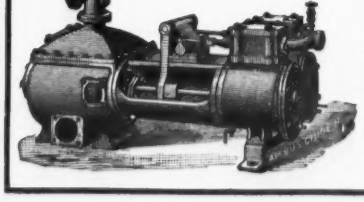

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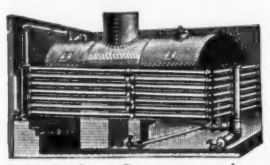

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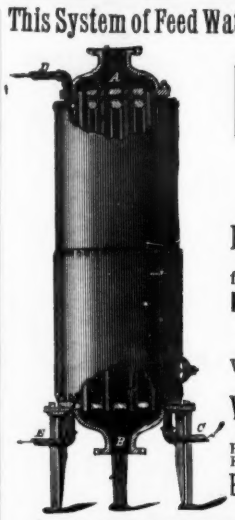

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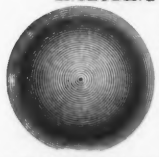

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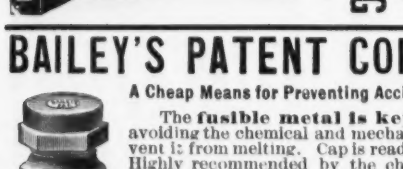

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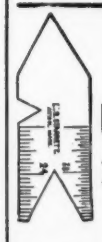

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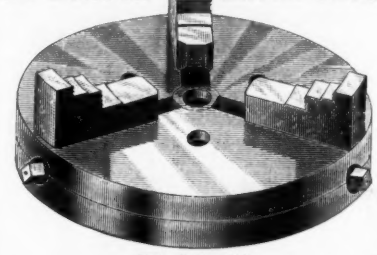

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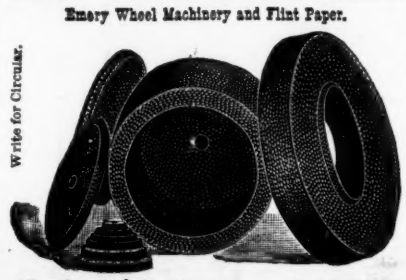

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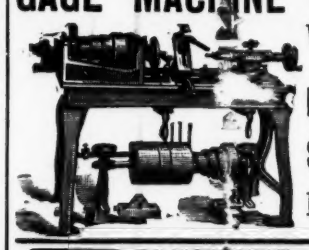

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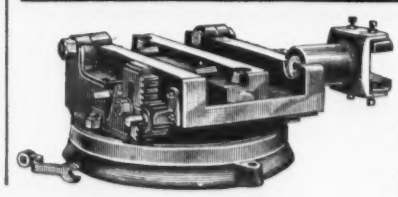

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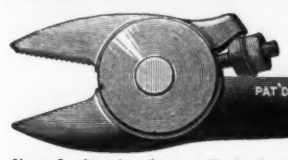

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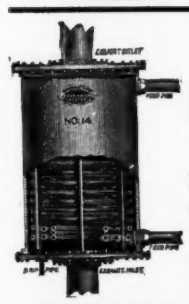

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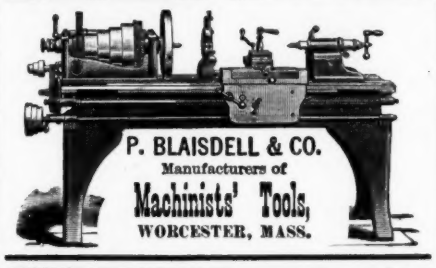

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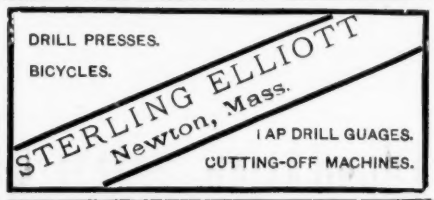

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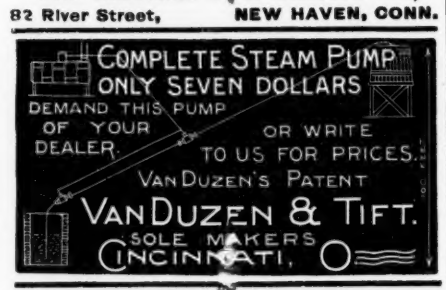

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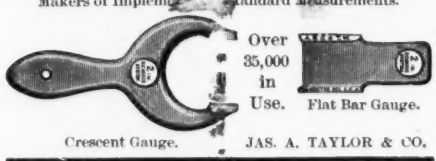

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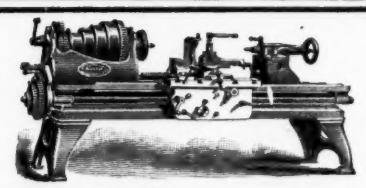

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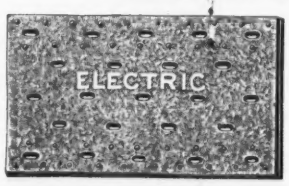

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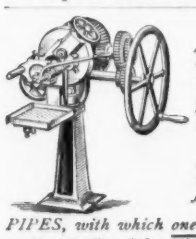

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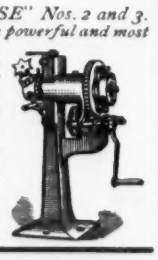

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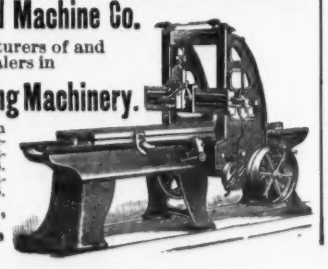

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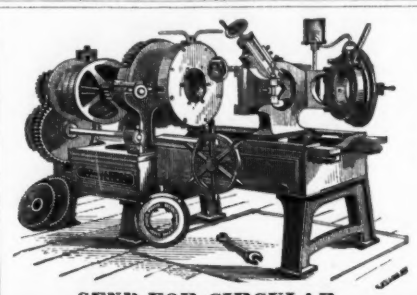

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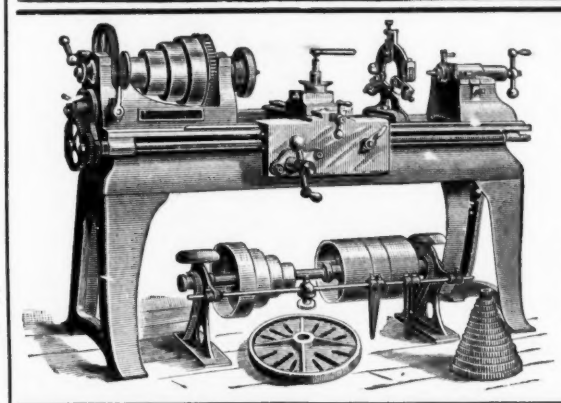

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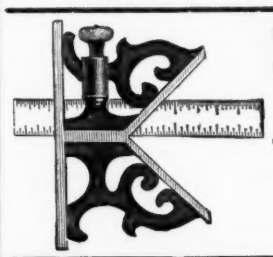

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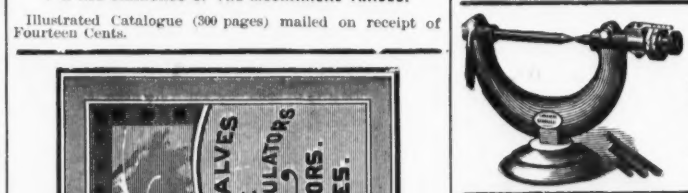

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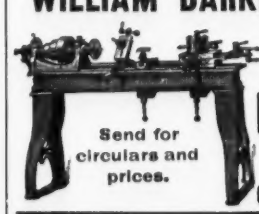

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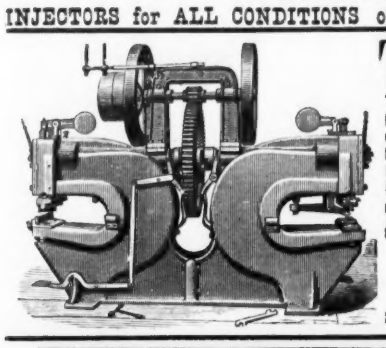

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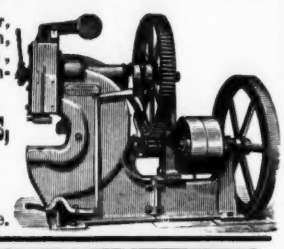

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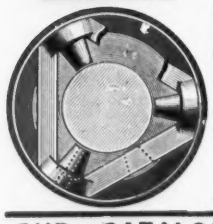

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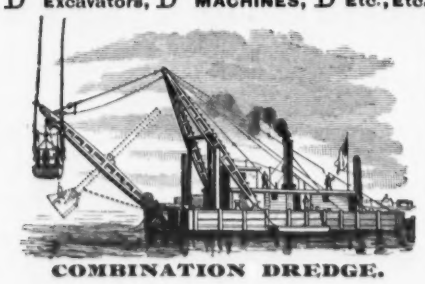

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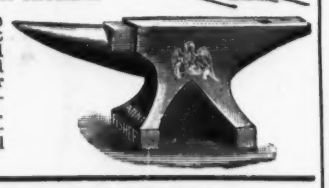

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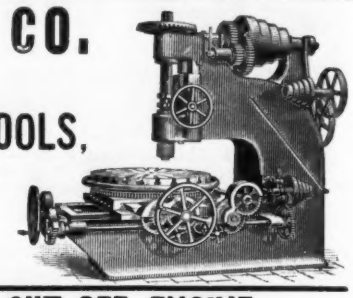

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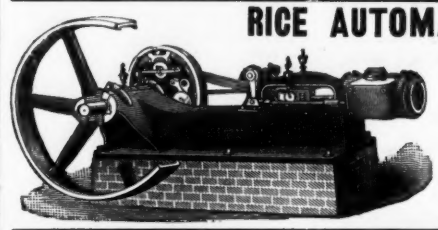

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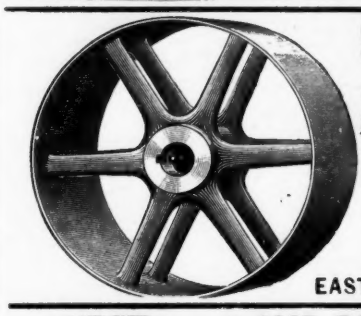

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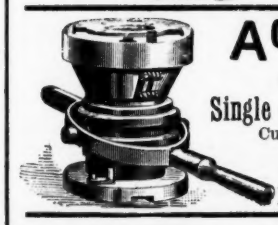

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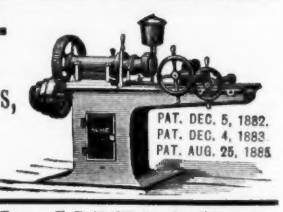

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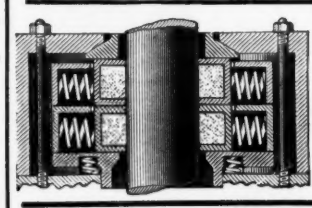

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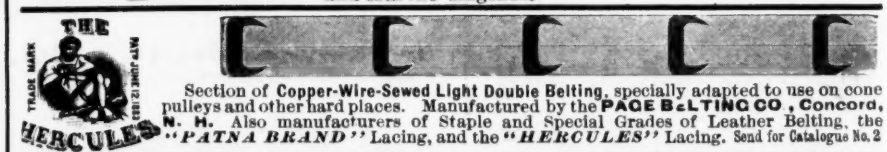

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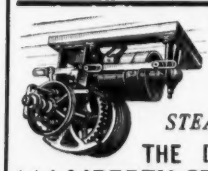

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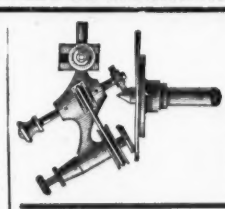

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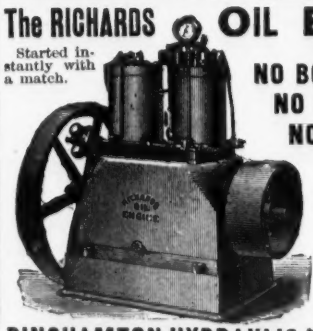

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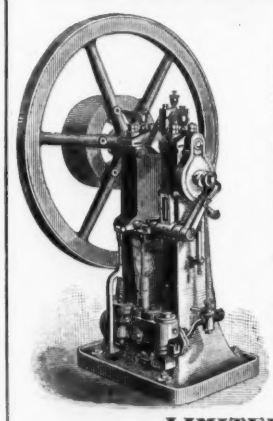

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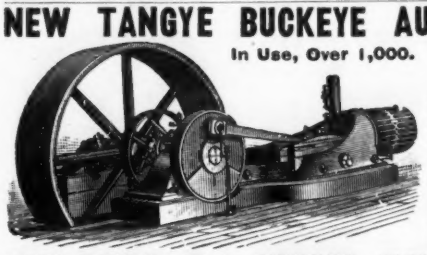

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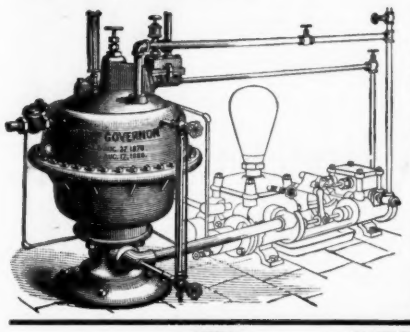

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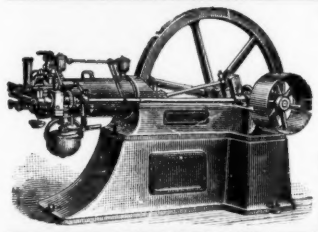

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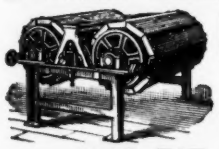

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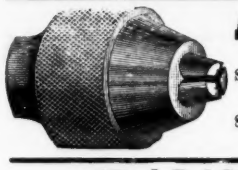

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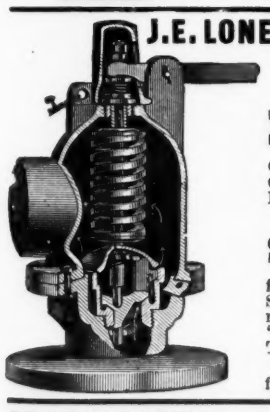

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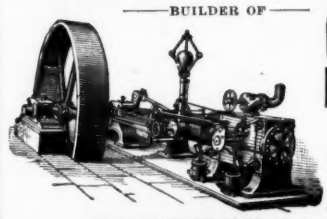

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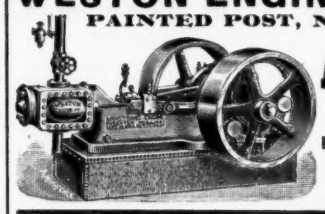

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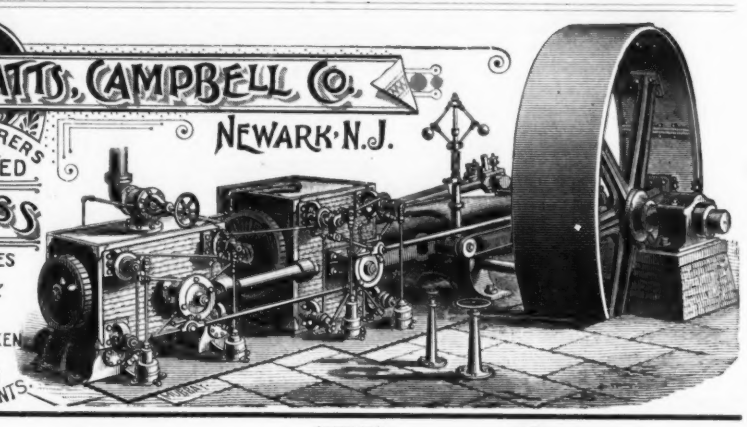
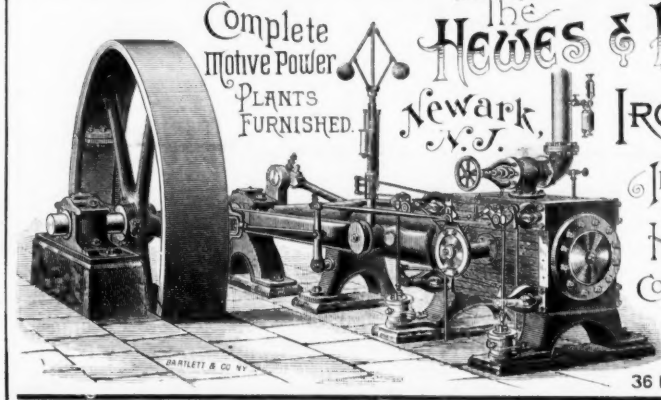


The HOWES & PHILLIPS IRON WORKS

Complete Motive Power Plants Furnished.

Newark, N. J.



Improved CORLISS ENGINES. High Pressure. Condensing and Compound TUBULAR BOILERS. HEAVY FLY WHEELS A SPECIALTY. IN SIZES UP TO 36 FT. DIA. BY 10 FT. FACE.

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FRICK COMPANY, Builders,

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NON-CONDENSING, CONDENSING COMPOUND.

40 TO 1,000 H.P.

Send for Circulars.

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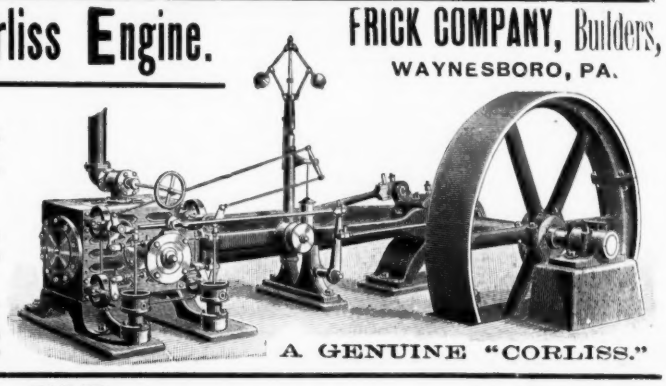

A GENUINE "CORLISS."

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MANUFACTURER OF IMPROVED

CORLISS ENGINES

ALSO SLIDE VALVE ENGINES

STATIONARY BOILERS,

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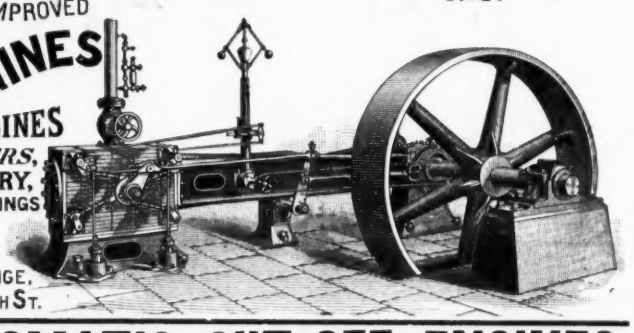
IRON AND BRASS CASTINGS

NEW YORK OFFICE ROOM 6, COAL AND IRON EXCHANGE, COR. CORTLANDT & CHURCH ST.



BALL AUTOMATIC CUT-OFF ENGINES,

ERIE, PA.

The characteristics of these Engines are Beauty of Design, Superior Finish, Limited Feet in Space required, Economy of Fuel, Perfection of Regulation.

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ENGINES from 15 to 400 Horse Power

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogue.

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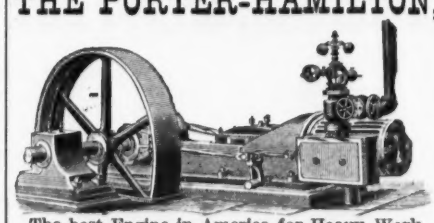

The best Engine in America for Heavy Work.

WILLIAM TOD & CO., Youngstown, Ohio.

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List of Second-Hand

MACHINERY.

15" x 6' Engine Lathe,	Lathe & Morse.
16" x 6' Engine Lathe,	Powell.
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18" x 6' Engine Lathe,	Blaisdell.
20" x 8' Engine Lathe,	Powell.
21" x 10' Engine Lathe,	Lathe & Morse, (new).
27" x 16' Engine Lathe,	Lathe & Morse, (new).
37" x 14' Engine Lathe,	Gleason, (new).
Cabinet Turret Lathe,	Lodge, Davis & Co. (new).
16 " x 16" x 3' Planer,	Lathe & Morse.
22" x 22" x 5' Planer,	Hendey.
26" x 26" x 6' Planer,	Hendey.
30 " x 30" x 8' Planer,	Bement.
36" x 36" x 10' Planer,	Whitcomb, (new).
15" Stroke Shaper,	Hendey.
Crank Planer,	Lathe & Morse.
20" Upright Drill,	Prentice.
22" Upright Drill,	Reed.
28" Upright Drill,	Bickford.

Above 2d-hand tools are in first-class condition. Write for prices and descriptions.

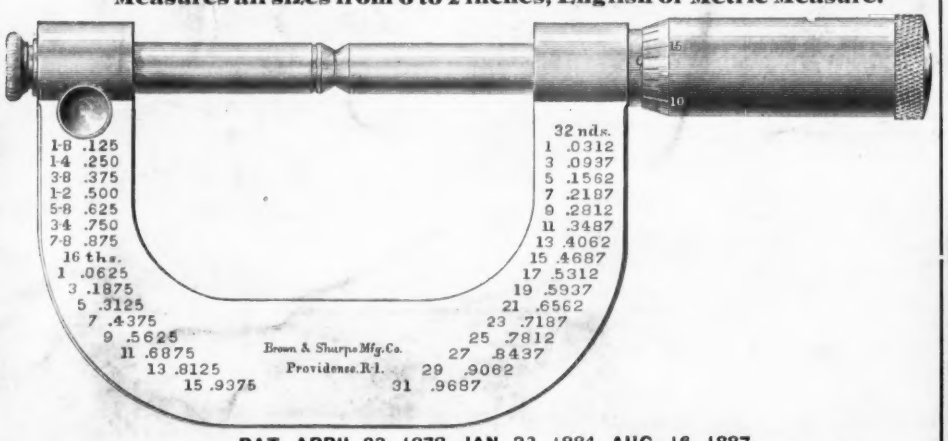
156 OLIVER STREET,

BOSTON, MASS.

BROWN & SHARPE MFG. CO., PROVIDENCE, R. I.

MICROMETER CALIPER No. 30,

Measures all sizes from 0 to 2 inches, English or Metric Measure.



PAT. APRIL 23, 1878, JAN. 22, 1884, AUG. 16, 1887.

PRICE, $8.00. **IN MOROCCO CASE, $9.00.**

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HAMILTON, OHIO.

MACHINE TOOLS.

UNIVERSAL

Radial Drilling Machines.

NEW PATTERNS, 1887.

Increased Power. Great Strength. Arm Rotates Freely. Quickly Handled. Drill-Head Balanced.

Patented May 10, 1887.

CRANES

THE YALE & TOWNE MFG CO.
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The Original Unvulcanized Packing

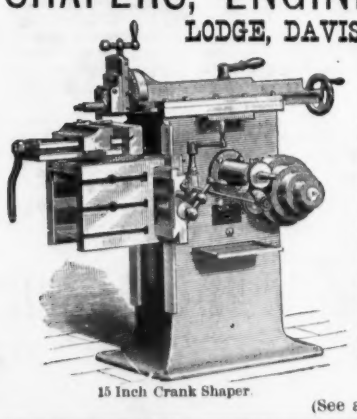
CALLED THE STANDARD—As it is the Packing by which all others are compared.

Accept no packing as JENKINS PACKING unless stamped with our "Trade Mark."

JENKINS BROS. { 71 JOHN STREET, N. Y. / 105 MILK STREET, BOSTON. / 21 NORTH FIFTH ST., PHILA. / 54 DEARBORN STREET, CHICAGO.

SHAPERS, ENGINE LATHES AND DRILLS.

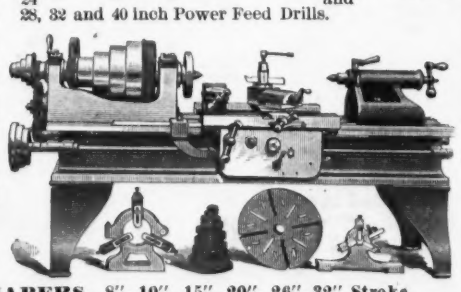
LODGE, DAVIS & CO., CINCINNATI, OHIO.



15 Inch Crank Shaper.

20 inch Upright Drills. 25 inch Back Geared, and
24 " " " and
28, 32 and 40 inch Power Feed Drills.

WRITE FOR PRICES, IT WILL PAY YOU.

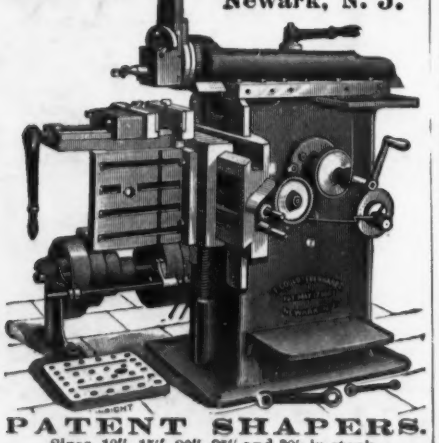


SHAPERS, 8", 10", 15", 20", 26", 32" Stroke.
ENGINE LATHES, 17", 19", 21", 24", 27", and 38".

(See advertisement, page 15.)

GOULD & EBERHARDT,

Newark, N. J.



PATENT SHAPERS.

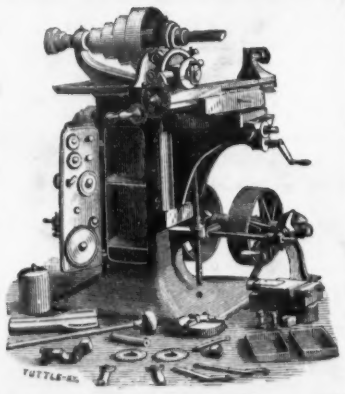
Sizes, 10", 15", 20", 25" and 30" in stock.

NEARLY 1,500 IN USE.

GEAR AND RACK CUTTING TO ORDER.

E. E. GARVIN & CO.,

Manufacturers of Machinists' and Iron Workers' Tools, Lathes, Planers, Milling Machines and Drills. Special Tools for all kinds of manufacturing to order.



Universal Milling Machine.

Gear and Rack Cutting, Milling and Index Drilling to Order.

Nos. 139 to 143 CENTRE ST., NEW YORK.

THE PRATT & WHITNEY CO.,

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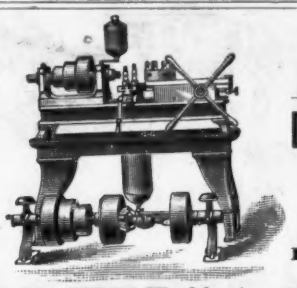
HORIZONTAL

Boring Mills,

48 in. and 66 in. Swing.



Double Head Traverse Drills

For 5/8 in., 3 in. and smaller holes.

Revolving Head Drilling Machines.

WESTERN BRANCH, 100 WEST Washington Street, Chicago, Ills.

THE BILLINGS AND SPENCER COMPANY,

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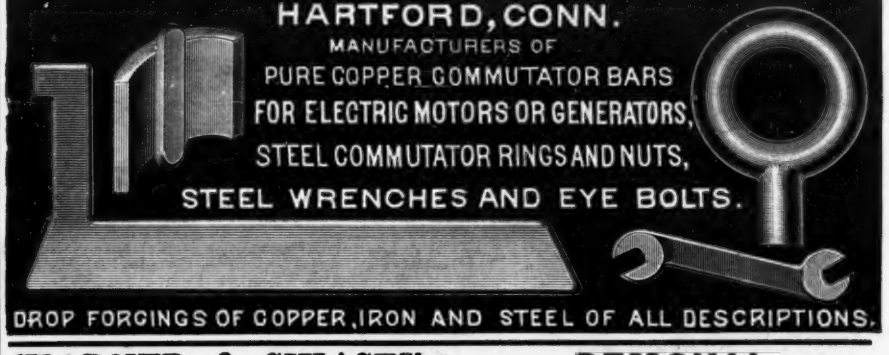
MANUFACTURERS OF

PURE COPPER COMMUTATOR BARS FOR ELECTRIC MOTORS OR GENERATORS,

STEEL COMMUTATOR RINGS AND NUTS,

STEEL WRENCHES AND EYE BOLTS.



DROP FORGINGS OF COPPER, IRON AND STEEL OF ALL DESCRIPTIONS.

WARNER & SWASEY,

MACHINE TOOLS CLEVELAND, OHIO.

For IRON and BRASS WORK.

Illustrated Catalogue on application.

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Manufacturer of ENGINE LATHES from 16 to 48 in. swing. Cuts, Photographs and Prices furnished on application.

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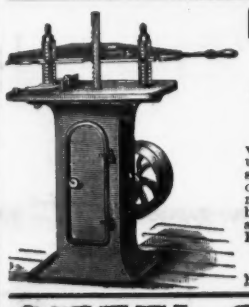
Gear Wheels and Gear Cutting.—I make g to order, or cut teeth on g blanks sent to me. Of all kinds. Of all sizes to six ft. dm. Small orders or large ones. Fine g or cheap g. Small cast g. Ready made brass g by mail at low prices. Bevel g with perfect planed teeth. Hand Book on g, $1. Facilities complete. Terms reasonable. Send for cat.

GEO. B. GRANT, 66 Beverly St., Boston, Mass.



KEY-SEATING MACHINES, and 20-in. Drills

A SPECIALTY.

Our Key-Seating Machine will save enough in 60 days' use to pay first cost; no shop can afford to do without one. We have now ready for prompt shipment both Key-Seating Machines and 20-in. Drills. Send for Photo. and Catalogue.

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NORTH BLOOMFIELD, N Y

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THE POND MACHINE TOOL COMPANY,

Formerly of Worcester, Mass.

The new shops of this company are located at Plainfield, N. J., forty minutes' ride from New York city on the line of the Central Railroad of N. J., and consist of the following:

A machine shop 500′ long by 100′ wide; a foundry 250′ long by 90′ wide; also commodious buildings for the storage of sand, coal, coke and pig iron; ample and convenient wash rooms for the men; fireproof two story pattern storage; blacksmith shop; engine and boiler houses. These buildings are detached from the machine shop and foundry. There is an elevated railroad for the convenient distribution of raw materials, and a railroad running through the machine shop for shipping. The whole plant is supplied with the incandescent system of electric lighting.

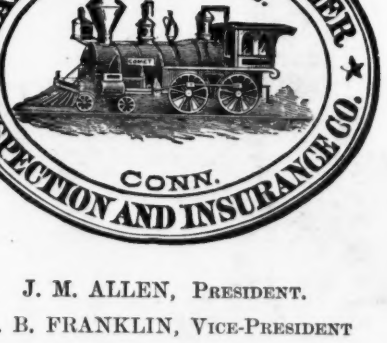
The machine shop and foundry have overhead traveling cranes running through their entire lengths; also light traveling cranes, which serve every tool, and a number of jib cranes in the foundry and scratch rooms. The foundry has capacity for making the heaviest class of castings.

All our tools are expressly designed for the economical manufacture of heavy machinery for railroad and general machine shop equipment, from new patterns of the latest and best designs.

SALESROOM and OFFICE, 111 & 113 Liberty St., N. Y. City.
NEW SHOPS, Plainfield, N. J.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

HARTFORD, CONN.



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PATENT UNIVERSAL SCREW-CUTTING CENTER DEPTH ANGLE AND **J. WYKE & CO., TWIST DRILL GAUGE.**

Fine Machinists' Tools.—E. Boston, Mass—Send for Circular.

NEW CATALOGUE

MACHINE TOOLS.

THE G. A. GRAY CO.,

477-481 SYCAMORE ST., CINCINNATI, O.

See advertisement, page 13.

STEEL CASTINGS.

PRATT & LETCHWORTH, PROPRIETORS

Buffalo Steel Foundry,

BUFFALO, N. Y.

PUNCHING PRESSES, DIES,

And other Tools for the Manufacture of all kinds of

SHEET METAL GOODS, DROP FORGINGS, ETC, DROP HAMMERS.

STILES & PARKER PRESS CO.

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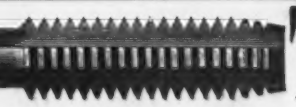

Manufacturer —of— TAPS & DIES